MAY, 1964

approach

THE NAVAL AVIATION SAFETY REVIEW

'The greatest cause of accidents is being physically present and mentally absent...'

Chas. Kettering

What is NOT A

These little things are often the seeds of big troubles

Forgetfulness

As a result of a thin 1200-foot overcast, a student pilot's second familiarization flight in the TF-9J was to be conducted under a local instrument clearance. The instructor was to assume control of the aircraft after takeoff and climb to VFR conditions on-top.

An instrument clearance was received and acknowledged. A transmission to "taxi into position and hold" behind another aircraft preparing to depart on an IFR clearance was simply "Wilco'd" by the instructor. The instructor rolled the aircraft into position on the runway and relinquished control to the student.

Shorty after the preceding aircraft had taken off, the instructor, acting under the misconception that he had been cleared for takeoff, directed the student to commence takeoff. The departure controller in the tower, not observing the aircraft rolling, transmitted an advisory intended to confirm the previously issued instruction, "_____216, hold your position."

At the time of this transmission, however, the aircraft had accelerated to 100 knots with about 3000 feet of runway remaining. When the instructor heard the message he immediately took control, chopped the throttle and commenced maximum braking. The starboard tire immediately blew and a right swerve set in. During this time the instructor felt

Aviation Safety?

he would be able to stop in the remaining distance and advised the student not to drop the hook.

The swerve had now put the aircraft onto the runway shoulder and the instructor increased port braking pressure, skidding the tire but not doing much else. Nosewheel and right main rode over the arresting gear chain. Due to the slow ground speed at this point the port gear just pushed the chain a little and the aircraft swung to a stop. The pilots evacuated without further incident.

On this incident the "comment and recommendations of the board" took all the space provided, and in remarkably restrained language such as: "It is squadron operating procedure for all pilots to repeat clearances issued by a clearance authority. The instructor violated this procedure. Proper repetition of the clearance would have enabled the departure controller to correct the pilot's mistaken belief that he was cleared for takeoff."

The skipper noted that "The subject of proper abort procedures was discussed with instructor and student pilots during the 'back in the saddle' program conducted after the recent holiday leave period. . . It is beyond comprehension that any instructor positively refreshed on these procedures within the previous 72 hours could commit such gross error."

A P-2 had aborted a takeoff due to a malfunctioning prop governor and after a governor change it was scheduled for a local test hop. During engine runup a discrepancy between bomb-bay fuel tank gage and low pressure warning light was discovered. The plane captain was sent into the bomb bay to physically check the fuel content of that tank.

After checking the tank the plane captain re-entered the aircraft but at the same time the attention of the pilot and copilot was distracted by a crew member reporting that an S-2 had lost a hatch on takeoff. The pilot reported this to ground control. There was a time lapse of approximately eight minutes between the reporting of the S-2 mishap and the resumption of the takeoff check list by the crew.

The aircraft was cleared for takeoff with neither the pilot, copilot or plane captain noticing that the bomb-bay doors were open. During takeoff and climbout, three garment bags were lost.

The aircraft check-off list is both purposeful and mandatory. It is imperative that it be restarted immediately after any interruption which necessarily breaks the sequence by requiring the manipulation of a system or switch previously checked.

Distraction

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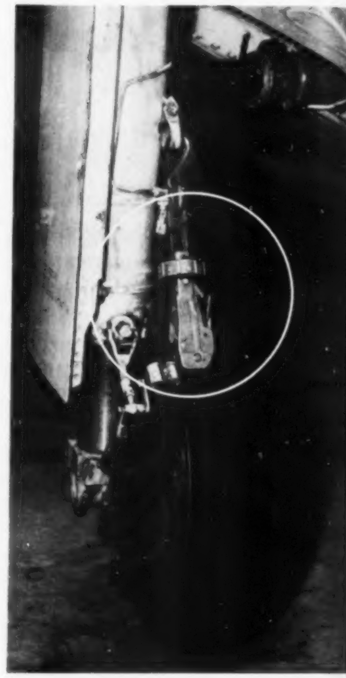
Assumptions



Circled is T-1A tiedown which remained on aircraft during flight from carrier to beach. Pilot attempted to get safe indication on port gear in the UP position and cycled gear seven times. In DOWN position port gear also indicated unsafe but landing was uneventful.

Pilot could not verify removal of tiedowns as he was strapped in prior to their removal. In this condition he has to rely on other personnel. Pilot was considered to have actuated the gear excessively and was fortunate landing gear did not jam in UP position. Recommendation was to make two recyclings the limit when encountering unsafe indication.

Poor Judgment

After 40 minutes of flight at 40,000 feet, the pilot of an F-4B could not move the stick to the right. He descended to below freezing level and after 10 minutes of flight at 12,000 feet the controls operated normally.

Then the pilot climbed back to 35,000 feet and after 20 minutes of flight the stick again could not be moved to the right. Pilot again descended to below freezing level and control was normal after 5 minutes of flight at 10,000 feet.

There was no further evidence of control malfunction and a normal landing was made. At that time the "Actuator Assembly, Lateral Controls Artificial Feel Trim" was removed from the aircraft and placed in a refrigerator at 28°F. for 20 minutes. It would not actuate to the *right wing down* position with application of normal force until it had been at room temperature for 5 minutes.

It was suspected that an absence of lubrication and close clearance between telescopic shafts caused freezing of the shafts and the actuator assembly was released to prime contractor for priority DIR.

There is no DIR for pilots but the judgment of the pilot to subject the aircraft to a second control malfunction is questionable. Once the known malfunction existed, the proper procedure should have been to land and have maintenance personnel determine the cause.

Inattention

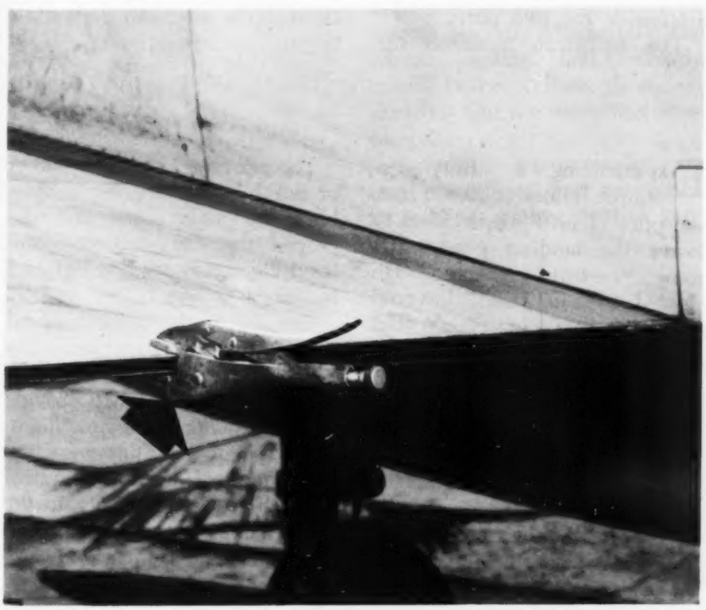
In mid-1961 there occurred an incident that was termed "incredible" by the local Fleet Air Commander. It wasn't published in APPROACH — it was too hard to believe. Then, two years later, the same thing happened, in violation of the old saying about lightning never striking twice in the same place. So it is worth reporting.

During weapons loading drills on an A-4C, vice-grip pliers were used to hold the flaps up as weapon and truck were being positioned. Upon completion of the drills the aircraft was to be flown to its home base and was then towed to the transient line, with the vice-grips still installed.

No qualified plane captain was available to assist the pilot. "Knowing that no qualified maintenance personnel had preflighted the aircraft," he said, "a very thorough preflight was initiated by myself." However, the vice-grips were still in place when the pilot took off for home base. Full flaps were selected.

At liftoff the aircraft had a strong tendency to roll to the left. This disappeared after gear and flap handle were pulled up. On lowering the flaps for landing the same rolling tendency appeared but the pilot trimmed for near normal flight and left the flap selector as it was. Landing was uneventful. When the aircraft was secured the vice-grips were still in place.

The second instance sounds almost like a broken record repeating the same story: During a weapons loading exercise a member of the loading team placed a crescent wrench (used as a clamp) on the starboard wing to hold the flaps up. The pilot did not see the wrench when he preflighted the aircraft. Damage occurred when the flaps were lowered during post-start checks.



Design Hazard

An A-4C cockpit filled with heavy blowing smoke immediately after takeoff. When the pilot switched from "normal" to "ram" air, blowing ceased but smoke remained. Pilot circled field, jettisoned full drop tanks to reduce the landing weight and landed. The air conditioning turbine was found seized and deformed due to overheating.

Before takeoff there was nothing mechanically wrong with the air conditioning turbine. The air supply was blocked off and it simply burned up.

Cause:

Pilot: On preflight inspection he failed to check cooling turbine intake.

Plane Captain: On preflight inspection he removed the metal handle from intake duct cover but failed to note that *plug itself remained in the duct*.

Design: Metal handle is merely glued to rubber plug used as a turbine intake duct cover, thus permitting easy separation of the two parts.

The squadron modified the duct cover by placing two bolts through the plug and the handle to prevent separation.

Lack of Knowledge

Experiencing a utility hydraulic failure at 20,000 feet, the pilot of an F-4B decided to lower the landing gear while some pressure remained. He slowed to 230 knots, lowered the gear but the nose indicated unsafe. Pulling the landing gear circuit breaker while continuing to decelerate, he monitored the angle of attack indicator instead of the airspeed. When the nose gear indicated down and locked following an emergency extension, buffet onset occured, followed immediately by a yaw to the right.

The pilot uncertain of whether or not he was entering a spin, blew the flaps down and deployed the drag chute. Stabilized flight was regained after a loss of 5000 feet.

Comment: It was determined that the pilot had erroneously relied on the angle of attack rather than airspeed to provide an indication of safe slow flight, even though his flaps were up. The angle of attack instrument is calibrated to indicate in the "3 O'clock" position at approach speed only with gear *and flaps* down.

Incomplete Information

At the end of a night cross country the pilot of an F-1E called the tower for landing clearance. He was given runway 22 and since he was a transient, the tower operator added that the runway was undergoing repairs, that the landing would have to be made on the right-hand side of a 250-foot wide runway.

Touchdown was made on the right-hand side but close enough to the center that the pilot could use the white centerline stripe as a guide.

With 3000 feet to go the white centerline suddenly vanished and flickering lights were seen close ahead. Heavy braking was applied but the aircraft struck two wooden horses which were part of a barricade placed around a newly asphalted section of the left side of the runway; the asphalt had been placed over the white centerline obliterating the line at the point where the barricade commenced. Standard flashing hazard marker battery operated lights were on top of the wooden horses.

Facilities: The flashing type markers appeared to be too weak to be clearly seen by the pilot. Tower instructions regarding the hazard on the centerline of the runway should have been more explicit.

Pilot: He should have favored the center of the usable landing area rather than staying just to the right side of the overall runway centerline.

Haste

Apparent affectionate nuzzling was actually caused by lack of brakes on unlucky "13." After impact pilot of "13" found starboard brake line disconnected (circled area).

Plane captain had changed tire and brake pucks but neglected to re-connect brake line before notifying hydraulic shop to bleed the brakes. Hydraulic shop man misunderstood aircraft number and bled brake on wrong aircraft. Meanwhile, the plane captain had already initialed the yellow sheet, indicating that the work was completed.

Squadron recommended no new procedures: Just adherence to existing quality control procedures.

Late in January the Naval Aviation Safety Center held its third Aviation Contractors Safety Representatives Conference with the theme human error problems. Following remarks by Rear Admiral Edward C. Outlaw, Commander of the Center, the kickoff report was made by CDR W. H. Hile, Jr., Head of the Center's Records and Statistics Department. Pertinent quotes from many of the conference presentations are interspersed in his report here, and in other related human factor articles within this issue. All major Navy manufacturers were represented, as well as headquarters safety people from the other services.

HUMAN ERROR

By CDR W. H. Hile, NASC

'If we must protect a system with over-elaborate safety precautions and complex, safety-oriented operating procedures which invite human error, we should question the system seriously.'

RADM E. C. Outlaw

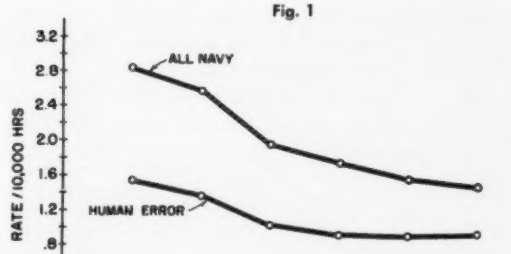
In keeping with the spirit of this issue, I would like to discuss the human error side of Navy aircraft accidents. Therefore the statistics presented here are pointed toward human error aspects of Navy aircraft accidents.

I have taken the liberty of reducing the term *human error* to include pilot error and error of other personnel. Pilot error, of course, is self explanatory. It includes all of his actions and inactions having a bearing on an aircraft accident.

Errors of other personnel, though less numerous, are more encompassing. They include the tower controller, GCA personnel, flight leader, supervisory personnel and maintenance personnel from the maintenance officer on down to the starting unit driver on the line. In short, it includes all humans concerned with aircraft operations and maintenance *except* the pilot himself.

With this background, let us now look at the statistics.

Fig. 1



ALL NAVY AIRCRAFT ACCIDENT RATE 58-63

Figure 1 is a six-year historical chart which depicts two curves. The upper curve is the all-Navy Aircraft Accident Rate and the lower curve portrays the Human Error Rate. Note that the

Although the all Navy or Navy/Marine aircraft accident rate has declined steadily over the past eleven years, a look at the last three fiscal years shows a change of causal factors which is grave and which calls for additional concern. . . There has been a percentage increase in human factor caused accidents from 52 percent to 62 percent!

More importantly, the accident which has "Pilot Factor" as the primary cause has increased in both number and percent from FY 61 to FY 63 . . . this means that the pilot is not getting better as the overall record improves. . . .

—CAPT R. E. Luehrs, MC, NASC

accident rate has declined from 2.83 per 10,000 hours in 1958 to 1.46 in 1963. During the same time, the human error rate declined only from 1.54 to .91.

An obvious deduction one can make from this graphic picture is that human error rate has not kept pace with the reduction in the all-Navy accident rate. As a matter of fact, the accident rate decreased nearly 50 percent while the human error rate decreased approximately 40 percent. Hypothetically, in a very short span of time, the human error rate could equal the all Navy rate. Realistically, we know this will never take place because our aircraft are machines and as such are susceptible to failures. The fact remains that the human error accidents are unacceptably disproportionate to the whole and have assumed an asymptotical trend.

Like the preceding chart, Figure 2 is also a six-year picture. Unlike Figure 1, two things are different. The human error accidents are divided between pilot and other personnel. Also percentage breakdowns are shown in lieu of rates per 10,000 flight hours. A switch was made from rates to percentages because the frequency of human error accidents to the total accidents appear more interesting and meaningful.

As you can see by inspection, the obvious deduction which can be reached is that both pilot and other personnel accidents, percentage-wise, have remained relatively static, that is 50 percent for pilot and 10 percent for other personnel. This is in spite of the fact that the all-Navy accidents decreased from 896 to 514.

Why the ratio of these two factors, pilot and other personnel error, have remained static is obscure. But such factors as placement of controls, aircraft control stability, high approach speeds, cockpit lighting both day and night, pilot comfort, and aircraft complexity, are all known to have contributed to this lack of progress.

Usually, human error is discussed in terms of (1) the results of the error, (2) the situation during which the error occurred, and (3) the personnel involved. However, the causative factors that precipitated the error are usually overlooked . . ."
—Mr. A. L. Steinberg, Bio-Factors, Douglas Aircraft

Figure 3 compares the human error rate as applied to the various Navy aircraft missions. Inasmuch as the human error factor has remained nearly static, the two most recent years were selected for comparison. Please note that on this chart the gray colored bars portray 1962 information and the black bars show 1963 data.

In the interest of saving space and for simplicity, comparable or near comparable missions have been grouped. Thus VF/VA reflects our fighter/attack missions, VP/VS our fixed-wing antisubmarine warfare mission, and VR/VW our logistics

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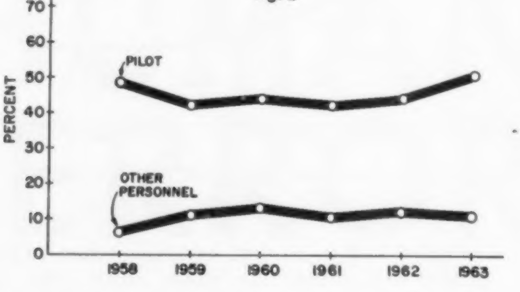
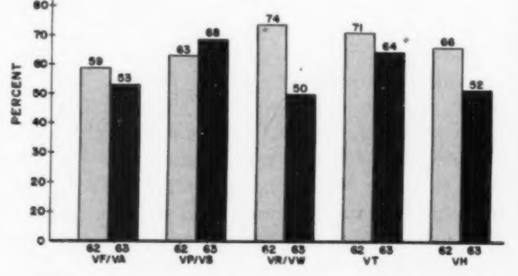
Fig. 2



PERCENT HUMAN ERROR ACCIDENT BREAKDOWN 58-63

Fig. 3



PERCENT BREAKDOWN HUMAN ERROR ACCIDENTS BY MISSION 62-63

and early warning missions. VT represents our training mission, while VH is the helicopter mission. Except for utility aircraft, which only represents 2 percent of the total, all our missions are represented.

Diverse as these missions are, you will note that not one mission had a human error frequency of less than 50 percent. In fact, the highest bar on this chart is the 74 percent in 1962 for VR/VW which is acknowledged to be our safest type flying. You would normally expect the human error factor to vary considerably among the missions shown. However, it can be seen here that human error caused accidents are not greatly affected whether applied to our safety mission (VR/VW) or to our most hazardous (VF/VA). Note that in 1963 the VF/VA human error percentage was only 3 percent higher than VR/VW.

The Navy's major striking force is contained in and reflected by our carrier operations; therefore, no statistical presentation would be complete without our embarked aircraft accident picture. Embarked, as used here, means *all accidents* occurring in conjunction with a carrier, be it carrier

. . . "In spite of the pilot's unavoidable identification with mishaps of whatever kind, the accident types most intimately associated with 'pilot error' . . . result in less costly aircraft damage, by and large, than accidents more closely linked with other causes, particularly material failure. The latter, moreover, has shown relatively little improvement between the first and second periods, as compared with the very pronounced decline in the Navy's overall aircraft accident rate. These data suggest that pilots may often have served as scapegoats in a way that has obscured the importance of these other factors."

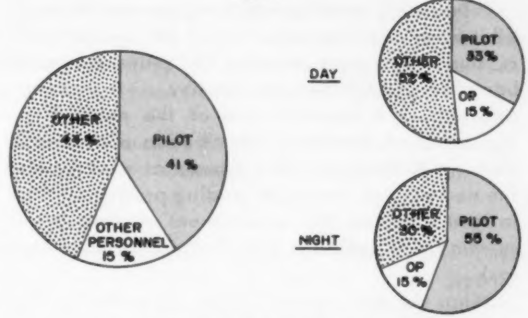
—Dr. G. T. Lodge, NASC

landing accidents, catapult takeoff accidents, or accidents in the vicinity of the carrier.

All data shown on Figure 4 are for 1962-63 and include fixed wing and rotary wing aircraft.

Two interesting facts are apparent from Figure 4. The pilot has 22 percent more difficulty during night carrier operations than he has during day operations. Secondly, it makes no difference to other personnel whether it is day or night. By way of explanation, the term "other" includes accidents caused by material failures or malfunctions, ship facilities, weather and undetermined causes.

Fig. 4



EMBARKED AIRCRAFT ACCIDENTS
62-63

The high night pilot error frequency should not come as a shock because we know that human faculties are not as acute at night. We know for a fact that the human eye, which gages and measures heights, distances and depth preception, does not function as efficiently at night.

Figure 5 is a breakdown of specific errors committed during 1962-63. These are errors adjudicated as primary causes. Although most errors shown are self-explanatory, additional information concerning these might be helpful.

Incorrect operation of aircraft system or components includes misuse of engine controls, improper use of, or inattention to fuel system, and improper use of auxiliary equipment.

Poor technique in flight includes such errors as

Fig. 5

Specific Human Errors

By Pilot	CY 62	CY 63
Incorrect Op. Syst./Components	18	16
Poor technique in grnd. op.	12	13
Poor technique in flight	21	15
Poor technique in landing	77	70
Misjudged dist./alt./or posit.	17	12
Failed to maintain flying spd.	10	14
Violation of regs/inst./proc.	21	13
Inadequate flight preparation	11	8
Physical condition of pilot	12	8
Improper flt. supervision	13	8
Miscellaneous	60	47
By Other Personnel		
Supervisory	43	35
Controlling	10	4
Maintenance	12	12
Support	8	6
Miscellaneous	4	2

"Frequently landing accidents are attributed to pilot error, and the reduction of the accident rate is sought by means intended to "reduce the number of errors." (Our) philosophy . . . however, arises from a consideration of the problem on the basis of statistical distribution and prediction . . . Reduction of the spread at once implies the necessity of increased landing precision, which in turn indicates the requirement of appropriate system modification to *help* the pilot in his control task . . .

What the pilot is *required* to do in the landing situation, rather than what he *is* doing, is of interest here. . . ."

—Barbour Lee Perry & Henry P. Birmingham
Naval Research Lab.

improper use of flight controls, exceeded stress limits and improper instrument procedure.

Poor technique in landing includes failure to compensate for crosswind, improper level-off, failure to extend landing gear, and improper response in carrier landing.

Miscellaneous includes a multitude of sins. They are grouped in this way because at the Naval Aviation Safety Center we have 25 possibilities in this category and rarely are there more than two in each. Miscellaneous includes among other things:

- Failure to complete checkoff-list,
- Failure to initiate action upon observing a mechanical malfunction,
- Preoccupation at a critical moment
- Improper emergency technique.

A glance at the pilot errors clearly indicates that our area of concern is poor technique in landing. This further substantiates the reasons given earlier such as poor cockpit lighting, aircraft control instability, and so forth. Suffice it to say that *we must give the pilot more attention.*

Other personnel errors should be explained.

Supervisory includes some 20 individuals or group of individuals. To name a few, the commanding officer, flight leader, training and scheduling officer, and most important, the quality control and maintenance inspection personnel.

Controlling includes such people as the landing signal officer, tower controller, GCA controller, catapult and arresting officer, and so forth. *Maintenance* includes all the hardware personnel. For example, structures, hydraulics, power plant, avionics and riggers.

". . . The problems arising from this naive belief that people can adapt to *any* circumstances if they only will . . . are still very much with us. For example, the requirements which a jet fighter pilot has to meet in order to make a successful night carrier landing press close upon the limits of human sensory and muscular adaptability, particularly if unfavorable sea or weather conditions are present to complicate the picture."

—Dr. G. T. Lodge,
Naval Aviation Safety Center

Support personnel are flight deck and hangar deck people, wheel watch, crash and rescue personnel.

Miscellaneous includes such people as flight crewmembers (other than pilots), operator of other aircraft and unauthorized operator of aircraft.

These are the facts. The *human error* problem is startling and in many cases catastrophic. Most certainly this is a fertile field in which a concentrated attack must be made in order to reduce the accident rate.

Supervisors must supervise. The facts known about human behavior must be applied vigorously as various situations dictate. Our flight surgeons

". . . we must do away with the sardine-can approach, with men crowded into, and immobilized in tiny working spaces. We must give them space enough to live comfortably. The human crew can increase the effectiveness of future aircraft systems by providing unique capabilities which cannot be replaced by automatic mechanisms. This effectiveness can be attained by providing a satisfactory environment to insure crew safety and performance. Man can provide those high qualities of intelligence, initiative, ingenuity, judgment and decision-making which are vital to the future of flight. And please don't forget that none of our other assets can compete with man in being mass produced, cheaply and by unskilled labor!"

—CAPT C. P. Phoebus, MC
Commanding Officer, Naval School of Aviation Medicine, Pensacola, Fla.

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. . . we decided however, that the greatest immediate improvement would come about through concentration on the lack of attention problem . . . Lack of attention, . . . is really an attitude problem and one very difficult to detect except in extreme cases. We were convinced that everyone was to some degree inflicted with this attitude problem, resulting in inattentiveness . . . The lack of attention was inevitably in direct proportion to the importance people placed upon the activity in which they were participating. . .

—Mr. James F. Halpin, Director of Quality, Martin Company, Orlando Division

must play an important role in detecting abnormal behavior *before* an accident takes place. Quality control and maintenance inspection must be given meticulous attention.

A vital area being vigorously scrutinized is design error which leads to human error during maintenance of an aircraft and in the cockpit during flight. One remedy, of course, would be to stop manufacturing parts or components which can be installed backward.

Today we have the technological capability to place a man on the moon. In spite of this ability, we still design and manufacture aircraft with hot air lines routed next to fuel lines, with parts and valves that lend themselves to misinstallation and with attention requirements that tax ability to the maximum.

For example, in one of our present aircraft a generator extension control handle has been placed next to a canopy jettison control handle. The score so far has been 10 canopies unintentionally jettisoned and, in one case, resulted in the loss of the entire aircraft.

A concerted attack on the *human error* problem through strict attention to details could and should produce both dramatic and gratifying results. We the humans control these statistics and therefore only we through "brute strength and awkwardness" can produce a significant reduction.

The *human error* accident rate has not kept pace with the progress and reduction obtained in the all Navy accident rate. Sixty percent or more of all our accidents involve human errors. Unless a concerted attack is made on the human error factor, 60 percent or three out of every five of our future accidents will *still* be caused by the human factor.

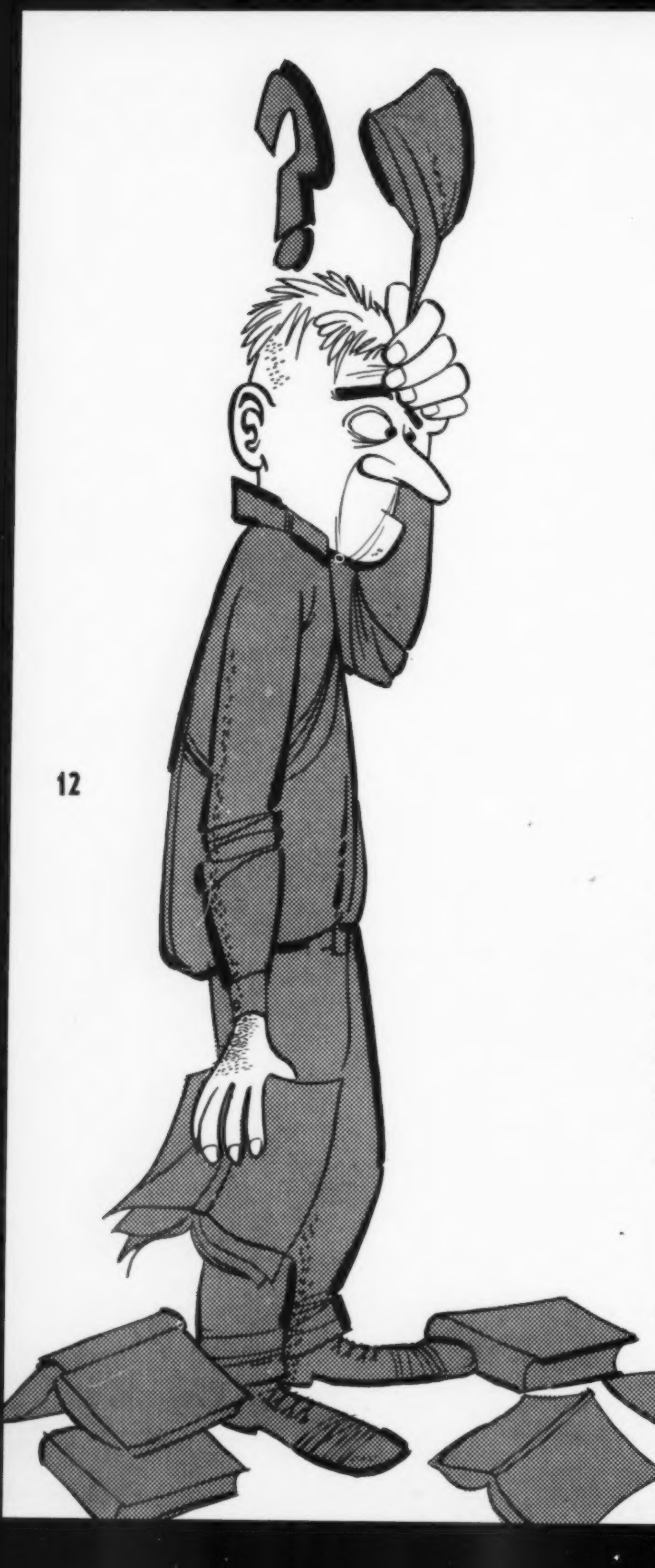
". . . I am particularly grateful to all hands in Naval Aviation for the substantial reduction in aircraft accidents during the fiscal year just ended — 6.5 percent reduction in total accidents and about an 18 percent reduction in fatalities. As heartening as this is, it is not enough. Most of our improvement has resulted from vigorous emphasis on material factors and standard operating procedures. Our work in these areas must continue unabated because there are still gains to be made here.

Human factors, however, are even more important in accident reduction than the material ones. Unfortunately, this is an area in which we haven't worked hard enough, either with air crews or supporting personnel.

These human factors, which contribute to . . . our accidents, are composed of such things as individual accident proneness (longterm as well as day-to-day) . . . poor training practices, disregard of orders, etc. An assualt on this facet of accident prevention has the potential of saving 50 to 100 lives per year, but this can be achieved only if those responsible, from the top down to squadron commanders, are convinced that accidents can be prevented without any impairment of operations. As a practical matter, nothing impairs squadron operations more than the loss of an airplane and an experienced crew.

Even though I will no longer be directly responsible, my interest in aviation safety will continue, and I have every expectation of a further and more significant decline in the accident rate. My plea is that each naval aviator work on this every day. Put your ideas in writing and send them up the line. . ."

—Remarks by Vice Admiral W. A. Schoech, on the occasion of his leaving the billet of DCNO (Air) for that of Chief of Naval Material



GENERAL PRUDENTIAL RULE

An underlying cause of many of our aviation accidents is too much "procedures and instructions" and too little common sense and supervision by the *key* people.

Far too often an aircraft accident report reaches the Naval Aviation Safety Center with an endorsement that may read similar to the following one which is quoted directly from an actual occurrence:

"This needless fatal accident was the result of non-compliance with standard operating procedures, and could have been averted had any one of a number of responsible people taken the proper actions and exercised the normal precautions required in all carrier operations.

"The principal cause of the accident is obviously personnel – personnel whose complacency or distraction permitted numerous contributing errors because of lack of supervision."

The first logical question that comes to mind is, "How come?"

One answer is the number of procedures, publications and instructions which pilots and supervisory personnel are expected to read, understand, and execute. This well meaning system, which is supposed to help these people, actually seems to be wrecking their common sense and setting them up for trouble; too much *procedures and instructions* and too little common sense and supervision by key people.

For example, the following publications speak of CCA procedures:

NWP-41
AirLant/AirPac CCA Instruction
Ship CCA Instruction
LSO NATOPS Manual
NATOPS Manual for each model aircraft (for discussion, assume six aboard)

Thus we have some three major and seven minor instructions on the CCA evolution, all written by different people and all modified from time to time by different people. Some are written from the pilots' point of view, some from the control point of view — but all on the same subject. It is *inevitable* that they will never all read exactly the same. (The simple subject of what the pilot hears, or doesn't hear, when he reports *meatball* varies slightly in the three major instructions.)

Disregarding the legal aspects, it is too much to ask any group of people to be required to read, understand, and execute this profusion of instructions — *safely*.

When a sequential *snafu* occurs resulting in an accident, an endorsement sometimes sets forth a correction to *one* of these instructions to prevent the same occurrence from happening in the future. The question then arises how about the other nine publications. It seems obvious that the need is for *fewer* and *better* publications and not mere corrections to one.

Even more startling than the number of instructions is the attitude and philosophy they seem to foster. The CCA/Landing process involves a *series* of actions by men and machines, including telephones, radar, radios, and so forth. The instructions, if followed correctly, detail the necessary steps to make safe operations — *but they never mention the dangers involved if one or more of the steps breaks down.* The net result is that people are lulled to sleep by a reliance on procedure and instructions which have worked many times before. It never occurs to them that occasionally something or someone could break down.

In the future, one solution is to include an opening paragraph in *all instructions* to the effect that some person *might* pass the wrong word or no word at all, somebody *might* turn on the wrong lights, some machine or equipment *might* go haywire, and so forth.

This seems so simple and straightforward that any supervisor worth his salt would not need to be cautioned. Unfortunately it is extremely hard to find people suspicious or inquisitive enough to go around asking such questions as, "How can this sequence be fouled up?" or, "How can some person or piece of gear mess up this procedure?"

All the basic safeguards in the world are worthless unless the supervisors really supervise and anticipate problems. Our overwhelming instruction system encourages exactly the opposite.

We have a general prudential rule for surface navigation, and a similar one for general operations might read as follows:

"When an operation or evolution depends upon the successful performance of a series of acts by men and machines, it is the duty of the supervisory personnel to be alert for possible failure of one, or a combination of these acts and to be prepared to take necessary action to insure safety."

How's Your Attitude?

By CDR F. T. Rooney, NASC

What makes aviators act in a safe way? Maybe it is because they are well informed regarding the need of safety; but information alone about dangers and hazards is not enough. It could be they possess skills which they practice regularly; yet skills alone are not sufficient. There is another factor that must be considered — one even more important than the others. That is *desirable attitudes*.

Aviators certainly must have good attitudes in order that they will utilize their knowledge and apply it to actual practices. They must possess the will, the desire to conduct themselves in a manner that will increase, not jeopardize the safety of themselves and others.

A safe individual is one who is well informed, possesses superior skills and desirable attitudes. These characteristics are ingrained in that individual by the *drive*, *spirit*, and *attitude* of the organization of which he is a part.

Attitudes Are Fundamental

Of all the factors of knowledge, habits, skills and attitudes, attitudes are the hardest to develop. They are caught, not taught, and are picked up from association with seniors and contemporaries. As a consequence, the run uphill against poor, weak or indifferent attitudes is a rough one. The responsibility to strengthen and redirect these attitudes is of paramount importance if the outfit is ever going to be worth anything.

Some points of special value in this endeavor are mentioned below:

Self-Preservation: Perhaps the most important of all personal desires is that of self-preservation, the desire of the individual to be free from danger and personal injury.

Attention should be placed upon the injury to the individual such as mutilated hands or holes in mountaintops rather than upon the accident as such in posters, notices and similar materials emphasizing the consequences of accidents. However, unless extreme care is exercised, undue emphasis of the negative phases of accident prevention will result, and excessive fear may be developed. *The purpose of safety education is to develop, not fear of injury, but rather an appreciation of the need for caution and awareness in everyday operations.*

Personal Gain or Reward: In this instance the desire for reward for work well done is the incentive. The desire of the pilot/crewman to excel urges continuation of interest. However, one must guard against the danger of overemphasis on achieving the reward and a consequent negation of the aims of the program (win the "E" at all costs regardless of working hours, duty sections or operating conditions.)

Loyalty: Here one wants to achieve the approval of squadron mates, to cooperate and to belong — as a group, as a team for the good of the team — to shout its praises or to defend it, with vigor and honesty.

Responsibility: Most individuals accept the responsibility connected with their jobs, but the degree of acceptance and eagerness to accept should be encouraged and nurtured. Delegate to those individuals the responsibilities which they are capable of assuming.

Pride: The display of craftsmanship in maintenance of flight proficiency and the subsequent winning of Safety Awards and Battle Efficiency "E's" will provide an incentive for the continuation of an organization's *state of the art* and will be reflected accordingly.

Rivalry: Both individual and group interest may be generated and maintained through friendly competition. Under careful guidance competition of this sort may well be used to develop attitude and safety.

Leadership: The desire for leadership is strong in many individuals and can be used to advantage. Persons possessing the qualities that work for good leadership should be selected as key men.

Personal Influence of an Individual: An individual with a strong personality who provides vivid experiences and also indicates his attitude on issues to those under his influence is likely to effect positively the attitudes of his listeners.

Prestige: Tends to influence, very favorably, the modification of attitudes. Attitudes associated with objects or organizations of prestige develop easily.

In accident prevention the *mental state* of the

individual cannot be overstressed. If he has gone his way wrapped in a cloak of indifference, unconcern, disregard, non-cooperativeness, and if the unit as a whole houses many such individuals, it is time for a splitting of the ends and tackles and an increased throwing of the ball.

If your shots strike home, the planning and execution of your new "offense" will be rewarded by comments such as, "The attitude in that outfit is great." Safety will be automatic, built-in and as precise as the reflexes of your *attitude conditioned* pilots and crewmen.

THE NAVAL AVIATOR'S GUIDE

Safety is frequently described as the byproduct of a job well done. With this thought in mind---that safety performance is merely a result of the whole man's professional training and attitude---Approach departs from its usual format and offers this review of an unusual book.

By Captain Malcom W. Cagle, U. S. Navy.
Reviewed by
Vice Admiral, Fitzhugh Lee

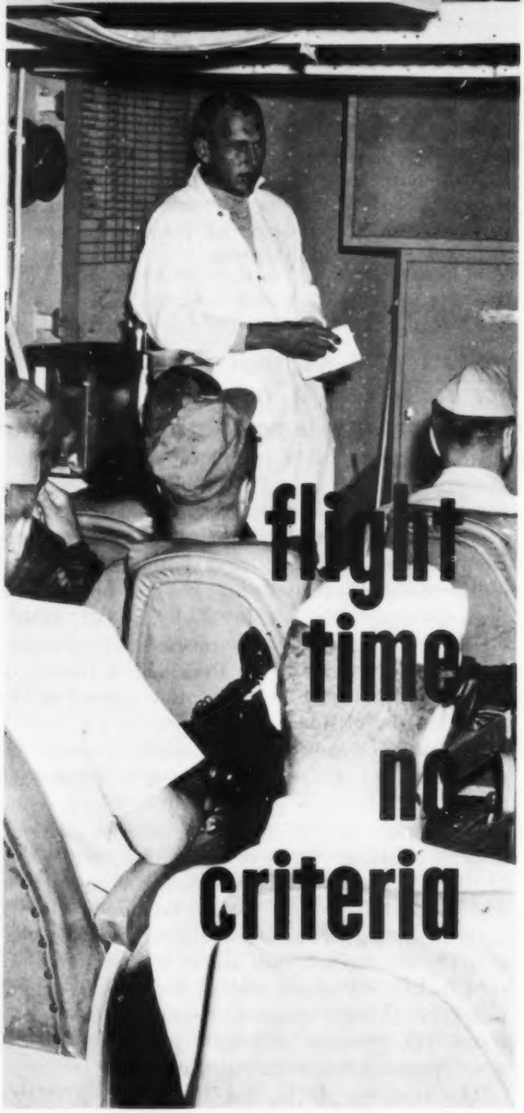
The need has at last been fulfilled for a single volume presenting the myriad facts, lore, etiquette, and organizational data which have evolved during the past 50-plus years of naval aviation. Five years in the making, THE NAVAL AVIATOR'S GUIDE is a welcome addition to the shelf of all officers connected with naval aviation. Along with the old standby reference works such as the *Division Officer's Guide* and *Watch Officer's Guide*, it should prove especially valuable to the fledging aviator with his new wings, but many oldsters will wonder how they ever did without it.

Captain Cagle has tied into one well-organized package a broad range of informative material about the "flying Navy." With 12 chapters ranging in scope from the history and mission of naval aviation to the proper preparation of a FUR (failure or unsat material report), the author offers well-categorized answers to the many questions concerning careers, duties, performance, and traditions that the new aviator will want to know and the oldtimer may have forgotten.

The author obviously believes that a knowledge of the history and customs of naval aviation will serve as an inspiration to the new crop of youngsters entering the fleet. The "Guide," with its chapters on traditions, history, and leadership, is most effective in this vein. The leadership chapter offers a fine discussion of the fundamental points of naval aviation science, points which are so essential that every naval officer must review them often. The chapter on history creates the impression that the growth of naval aviation has been smooth and unopposed both from within the Navy and without. However, oldtimers will recall that such, has not always been the case. While THE NAVAL AVIATOR'S GUIDE is not the place for a comprehensive history, it is to be hoped that such a history of aviation in the Navy may one day appear in the Naval Institute's book list.

The two appendices and glossary of terms are very complete. Information which is often hard to locate just when you want it, such as complete listings of the new aircraft designations, aircraft markings, flight deck uniform colors, how to identify electronics-communication equipment, and ship designations, is all included. Also, a current listing of aviation ships, statistics concerning all operational naval aircraft and all records held by naval aircraft are at your fingertips. The glossary of current naval "aviation-ese" terms will prove to be helpful to the aviator and a welcome reference for his wife.

The reviewer feels that the only regrettable omission in the spectrum of naval air activities was a chapter on the Naval Air Reserve and the important role played by the Weekend Warrior in the aviation structure. This would appear appropriate because of the large number of naval pilots who may affiliate with the Reserve upon completion of active duty. Possibly some information on the Naval Air Training Command would have also been helpful, since nearly every naval aviator will return to this command for at least one tour of duty. Perhaps the Weekend Warrior and the Naval Air Training Command will find a niche in the next edition. . . .



flight time no criteria

A recent accident has brought to a head a problem that is constantly cropping up in AARs and Anymouse Reports. The problem is incomplete crew checkout or training and pertains more to the pilots than other crewmembers with special, limited duties. A brief resume of this accident may serve to stress the point.

The pilot and copilot, alone in the aircraft, were flying down the west coast on an instrument flight plan. After two hours of flight the starboard engine fire warning light came ON. Smoke was observed to be coming from the top of the engine and the pilot ordered the engine be secured. A turn back to a landing field was initiated and during the turn the pilot allowed the aircraft to enter an unbalanced flight condition and subsequently lost control of the aircraft. It had been previously noted that this pilot was weak on his emergency procedures and especially single engine procedures. After control was lost the pilot gave the word to bail out.

The copilot went aft to the hatch but was unable to jettison it. The inability to get rid of the door was primarily due to his lack of knowledge of the location of the jettison handle. This, coupled with his unfamiliarity with the assigned duties of the crewman normally carried in the after station, led to an abnormally long delay in bailout. The word to get out was passed at an altitude of 9000 feet but witnesses on the ground stated his bailout occurred at about 2000 feet. The pilot followed shortly after but his chute did not open. The accident board concluded that he was either incapacitated by the gyrations of the spinning aircraft prior to bailout or was struck by the plane shortly after his exit.

This accident cost the Navy one pilot, $603,000, and a drop in operational readiness of the squadron. "An occupational hazard," you say, "bound to happen now and then." Sure, aircraft accidents are an occupational hazard and are bound to happen occasionally but this type of accident is about the most needless waste there is. This accident could have been prevented a half a dozen or more ways.

A similar thing happened not long ago on the east coast. The accident was different but the basic cause was the same. In this instance a jet pilot found himself in the blue without electrical power—an uncomfortable but not uncommon type emergency. On his return to the field he was given a green light for landing on runway 25, the duty runway. The wind was calm or light and variable and the free swinging tetrahedron was favoring runway 7. The pilot again crossed the field and the tower, assuming the pilot would turn downwind for 25, gave another green light. Well, as maybe you've guessed, the pilot landed the wrong way on a one way street and ripped through the arresting gear going the wrong direction. Instead of retarding the throttle and brakin to a stop in the 5500 feet of runway remaining he tried to wave off. The combination of high power, high rotation angle and no electric fuel boost pump gave indications of a power loss and the pilot ejected at 100 feet.

Unfamiliarity with emergency procedures cause dangerous distractions.

The ejection attempt was outside the safe escape envelope for the system and the chute did not have time to deploy. Once again lack of knowledge and poor judgment dealt a fatal blow.

These accidents are not isolated cases. What's more, not all cases of lack of knowledge and poor judgment end in aircraft accidents. A good many instances get passed off with a shrug of the shoulder, a wipe of the brow and a stern warning from the safety officer, if he happens to hear about it.

Certainly there must be some very evident reasons behind the large number of pilot caused accidents. The one big factor is the aircraft itself. In our efforts to match and outdo the performance of any potential enemy aircraft we have designed ourselves right into a corner. Starting with the old Mk O, Mod O bird with a wing or two, a cantankerous old engine and a few cables hooked to a stick, there wasn't too much for a pilot to know about his bird. When something went wrong he glided into a pasture, took out his pliers, screwdriver and bailing wire and in short order was back in the air. Soon to follow was a slightly larger aircraft, with a larger, more complicated engine and wheels that went up and down. When these birds developed trouble they had to be landed on an airfield and a mechanic was usually called in. Through the years we have rapidly progressed to the Mk 10, Mod 16 era with multi-engines, yards and yards of hydraulic lines and miles of electrical wiring. All systems are double systems with double-double back-up systems, but the pilot is still a man.

How can the pilot progress with our aircraft? Through training. This is the only way to keep up. It's not enough to train under only ideal conditions or to practice only the normal aspects of flight. When was the last time you feathered an engine for drill or dropped your landing gear via the emergency method? Could you do it in the dark, without a checklist? The modern aviator, if he is to cope with the unusual situations or emergencies in our complex aircraft, must train under these situations either in actual flight or by simulation. It is not enough to merely practice to get by a flight check. You have to train until you know it cold and then practice often to keep current. You're only fooling yourself if you think you can get by with reading the emergency procedures section of the Flight Manual.

Emergency procedures exercises should include as many drills as there are combinations of possibilities. If you are a plane commander you should be as well qualified in the duties of your crew as you are your own. There is no substitute for thorough, realistic training, and the general standard of plenty of flight hours does not, in itself, constitute a blanket qualification.

Simulators offer low cost practice.

HUMAN FACTORS ENGINEERING

The role of the human factors engineer in accident prevention is, to some extent, recognized by the safety practitioners. There is evidence, however, that such engineering has not been fully exploited as an accident prevention tool. To stimulate additional consideration of human factors engineering as it applies to accident prevention, the following is excerpted from an article by W. E. Tarrants appearing in the February, 1963 issue of the *Journal of the American Society of Safety Engineers:*

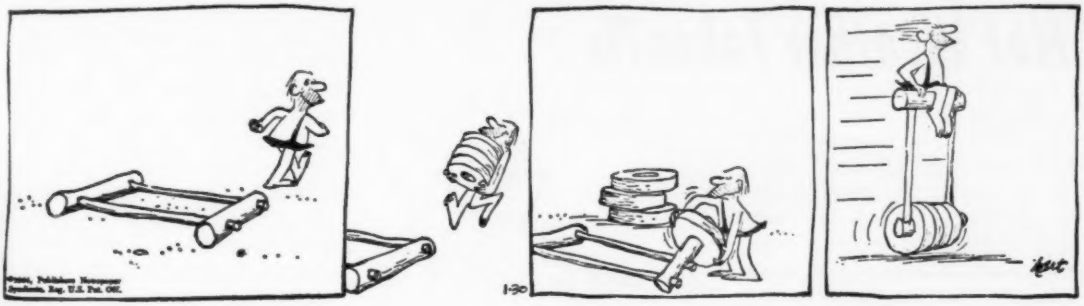
The initial reaction of many people to the idea of "forcing" a person to perform within certain limits is one of rejection. Living without the freedom of choice to deviate from a limited behavioral bandwidth is somehow considered undemocratic by many. To improve the performance characteristics of man-machine systems, one has the choice of either trying to alter the man so that he better fits the machine, or modifying the mechanism to fit a certain population of operators.

The latter approach is that of the human factors engineer, while efforts to adapt the man to the machine characterize the work of the training expert. In terms of error reduction and accident prevention, it appears that a limited behavioral bandwidth must be specified within the context of specific man-machine-environment systems if the safety of the operator and the objectives of the system are to be realized.

In the accident prevention field in the U. S., the educational approach has traditionally received the greatest emphasis. There appear to be several reasons for this popularity.

- *First*, many persons charged with providing safety program decision-making information are not technically equipped to perceive human factors engineering solutions to contemporary man-machine error or accident problems.
- *Second*, the short-term costs of safety training are less than those involved in many engineering modifications of existing man-machine-environment systems.
- *Third*, since it is difficult to "engineer-out" all sources of errors or accidents in many present-day man-machine-environment systems, the conclusion is often reached that the education approach is more effective in accomplishing the desired results.
- *Finally*, safety practitioners often assume a direct "cause-and-effect" relationship between the presentation of a training program and on-the-job improvements in safety behavior. The problems of performance under stress and temporary impairment of functions resulting from fatigue, monotony, lapses of attention, mental problems, physical problems, lack of motivation, and other intervening variables are often overlooked.

Taylor and Garvey[1] have taken a rather critical look at the training approach to reducing error in man-machine systems. They labeled the training emphasis "procrustean" after the legendary highwayman and innkeeper who "adapted" his vic-



tims to the exact dimensions of an iron bed by either stretching them out or cutting off their legs. In particular, the authors considered three limitations: (1) the long-term high cost of training, (2) the often limited effectiveness of training and (3) the disruption of performance under stress.

The long-term high cost of training in terms of both money and time is one of its most obvious and serious limitations, according to Taylor and Garvey. They admit that it is not possible to dispense with some type of training in a majority of work situations, but they emphasize that ". . . in certain man-machine systems, adequate engineering of the machine reduces training requirements enormously."

The second limitation of training in the systems context is that it sometimes fails to work. The authors point out that no amount of training will make some man-machine systems function successfully. For example, no pilot, regardless of how highly practiced and skilled he may be, can, without devices to aid stabilization, position an airplane with sufficient accuracy for missile firing. In order to bring this and other systems up to a tolerable level of performance, it is necessary to shift some of the burden of controlling from the man to the machine. This might be done, for example, by building into the aircraft a data processing network which would compute control information before it is displayed to the pilot.

Although the high cost and limited effectiveness of training are disadvantages in many systems, these two items do not necessarily constitute positive dangers. Evidence is beginning to accumulate from a series of "task-induced-stress" studies conducted by Garvey[2] that an unenlightened use of training may actually constitute an operational hazard.

To date, the studies suggest that stress disrupts most of the performance of those man-machine systems which place the heaviest demands upon the operator. In one of the experiments, the stress effects were measured for two systems of different human engineering merit, but which had been equated in performance before stress by operator training. There was no significant difference between the two systems after training without stress. However, with five out of six different forms of stress, performance was disrupted significantly more in the system that was not designed with human engineering considerations.

The results of these and other experiments have made it clear that, although differences between systems in human engineering terms may be masked by training, the superiority of one system as compared with another may reassert itself when the operator is called upon to work under stressful conditions. Taylor and Garvey concluded that ". . . in some cases, the use of training to optimize the performance of a man-machine system may, like papering over the cracks in a wall, have serious and undesirable consequences. Certainly, if systems must perform well in other-than-optimum situations, training in the absence of stress should not be used as a substitute for adequate equipment design."

1. TAYLOR, F. V. and W. D. GARVEY, "The Limitations of a 'Procrustean' Approach to the Optimization of Man-Machine Systems," *Ergonomics*, Vol. 2, No. 2 (February 1959), pp. 187 – 194.

2. GARVEY, W. D., "The Effect of 'Task-Induced Stress' on Man-Machine Systems Performance," U. S. Naval Research Laboratory, *Report No. 5015*, 1957.

Hot Weather Takeoffs

Today, I received a poster in the *Crossfeed* sent out by NASC. It announced in big, black letters, **"HOT WEATHER TAKEOFFS REQUIRE MORE RUNWAY."** I said to myself, "Well, that's pretty obvious." And yet, not six hours earlier, the advice had a very real and personal meaning.

I was enroute to an east coast air station in an A-4B with a buddy store aboard to play teenie weenie tanker for some of the *Fury* boys. The servicing stop was made at Kirtland AFB. When I got there, I knew I'd need plenty of fuel for the trip east, so I had them top the aircraft off including full drops. With the weight of the buddy store added, gross weight was just a tad short of 20,000 lbs. Since I planned an early morning takeoff, I figured on no strain, despite the fact that Kirtland is at 5352 feet.

I entered the charts with 20,000 lbs., 28°C. runway temperature, and 5100 feet pressure altitude. The answer was a little less than 7000 feet of roll. With 12,000 feet of runway available, this provided plenty of margin for error, *I thought*. Taxiing out, I noticed I had to hold quite a bit of left brake. The taxiway was pretty level and the wind was calm, so I suspected that the right brake was dragging a bit. Sure enough, I had to use an abnormal amount of left brake during the first part of the takeoff roll. In addition, the engine was putting out a little less than 99 percent with 630° EGT. This was a bit less than ideal, but still within limits.

Lift-off speed should have been 145 knots. As I passed 7000 feet, I had about 140. I lifted the nose to the takeoff attitude as indicated on the angle-of-attack. The bird just sat there while the last 5 knots built up. At 145, I could hear the landing gear handle solenoid chattering, so I know I was just about to lift off. Trouble is, I was rolling past 10,000 feet. The bird finally struggled into the air as the 1000-foot remaining marker went past. I raised the gear immediately to reduce drag. There's a pretty fair drop-off at the end of the runway, so there was no problem with terrain clearance. I eventually gained altitude and airspeed. As I hit 200 knots, I reached over to raise the flaps. *They were already up.*

With all my careful calculations, I had forgotten to set the flaps at 1/2 for the takeoff. I distinctly recall going over the takeoff checklist before taking the duty as I always do. I probably looked at the flap indicator the same way guys look as the wheels indicators and then make a wheels-up landing.

The combination of too much brake, not enough thrust and no flaps just about used up all **the margin I thought I had.**

I learned that—*Hot Weather Takeoffs Require More Runway*—and a bit more headwork.

APG-53 Radar Scope

This incident occurred on a night cat shot. I received the radar scope in my lap.

While still under the influence of the power stroke I noted the stick too far aft and about the time the bridle fell off I recognized the radar scope as the cause. It positioned the stick full aft and about two inches left. For some unknown reason I

ANYMOUSE

The purpose of Anymouse (anonymous) Reports is to help prevent or overcome dangerous situations. They are submitted by Naval and Marine Corps aviation personnel who have had hazardous or unsafe aviation experiences. As the name indicates these reports need not be signed. Forms for writing Anymouse Reports and mailing envelopes are available in readyrooms and line shacks. All reports are considered for appropriate action.

— REPORT AN INCIDENT, PREVENT AN ACCIDENT —

pulled the scope out the rest of the way, flipped it over to the right, then pushed the stick forward and to the right as the aircraft started shuddering. I checked my all attitude gyro and got wings level and about 5 degrees nose up. I then checked altitude . . . 150 to 200 feet, airspeed 165 knots. My gear had been retracted upon completion of the cat shot.

At about 200 knots I brought my flaps up and continued climbing. The radar scope was lying on my right knee, somewhat in the way.

I completed the climbout and then attempted to restow the radar but the aircraft would roll rapidly left as the stick had to be displaced in order to restow the scope. Twice it partially jammed on the way in and I yanked it out again. The third attempt was successful. I positioned the safety latch and completed the hop.

Checking with our ATs, it was determined that in all probability, the scope was not fully seated when the instrument clamp assembly was tightened. The safety latch assembly was tightened in position, but neither one of these items actually locks. It is thought that the clamp became loose, permitting the radar scope to move forward the additional ⅛ inch on an arrestment, and then the safety latch was free to rotate out of position. A cat shot would then throw the scope out of its stowed position. A screw placed into the instrument panel just beneath the safety latch would prevent the latch from falling out of place. It would have to be rotated upward in order to remove the scope. Also it would be wise to fully seat and lock the scope in place with the safety latch and then tighten the clamp when the scope is fully seated.

All pilots in our squadron check the position of the safety latch prior to getting into the cockpit.

Swallow Your Pride

This Anymouse returned from a low level strike into France with surplus fuel and time, having aborted the low level portion of the route due to weather. At this point he decided to really cooperate as a returning friendly to the point of tracking inbound to one of the control destroyers before proceeding to marshal. This worked out fine and he switched to the carrier's approach control frequency, then proceeded to the newly assigned marshall where he entered holding.

Since some time had elapsed since his last hop, this was head in the cockpit work at marshall. Two other aircraft from the same squadron arrived at marshal; however, he didn't see them. They announced pushing over on time. Anymouse was 10 seconds late with a state of 2000 pounds at 33 miles and 18,000 feet. The other flight called Popeye and since Anymouse was obviously VFR, he realized something was wrong. Checking the tacan selector, it was still indicating (after some 20 minutes of holding) the control destroyers channel vice the carriers. He immediately switched and leveled off at 12,000 feet. He got a good lock on and ID, checked it against UHF/ADF. He decided he could make the 111 miles indicated in about 14 minutes and land within the normal recovery time, avoiding any real embarrassment.

At station passage he was overhead a cruiser and it was getting pretty lonely out. Anymouse immediately commenced a climb with 1100 pounds of fuel indicated and called the carrier to verify tacan sweet and to locate a tanker. Again the tacan locked on indicating 48 miles on the same heading. This seemed reasonable so he stayed low, called the carrier for radar monitor, came back to maximum endurance and began a DME/fuel gage scan pattern.

The happy ending to this tale is that CCA rendezvoused him with a tanker at 15 miles from the ship, 1000 feet.

He plugged in with 600 pounds of fuel indicated. Although a landing could have been effected without tanking, this was a safe precaution. The landing with 1800 pounds was anticlimatic.

Several things entered into this episode ranging from the gross stupidity of failing to change tacan channels and even worse, not checking while in the marshal pattern, to a decision for a low altitude trip to the carrier, in an attempt to cover the first blunder. The aircraft had a functioning ASN-19 which was essentially correct and would have revealed the erroneous marshal had it been checked. The decision to make the recovery time even at high fuel consumption could have resulted in a poopy suit part very easily. This Anymouse will be a more conscientious channel checker and pride swallower in the future.

(An error was also made by setting maximum endurance power vice maximum range power for the last 48-mile trek to the carrier — Ed.)

Headmouse

NC-7 Backfires

Dear Headmouse:

Backfires from an NC-7 sometimes shoot flames one to one and one-half feet wide out of both exhaust stacks. This situation can be dangerous. Fuel or fuel fumes are always present around aircraft and can be ignited at any time — especially during or after the plane captain has inspected fuel and fuel drains.

Backfiring in most cases is caused by turning the NC-7 ignition switch OFF too soon after engine run-up at high speed to supply required power to the aircraft. This is particularly true if the switch is cut immediately after the throttle is returned to IDLE.

Recommend that operators be required to idle the NC-7 two to three minutes after high speed run-ups before cutting the switch. An alternative would be to fix the NC-7 so that after-ignition cannot occur.

AVIONICSMOUSE, VS-39

► Concerning stopping procedures you're in the ball park, Avionicsmouse. NavAer 19-45-529, page 9, para. 3-22 states: "To stop the engine, return the throttle to IDLE, allow the engine to idle a few minutes, then move ignition switch to OFF." The instruction plate mounted on the unit states: "Run 1 min. at idle before securing." Operators who have been qualified by NAMTG instructors and who are licensed in accordance with OpNav. Inst. 3500.26A have been instructed to idle the engine for 3 minutes before cutting the switch. It appears there are plenty of sources for the word but the velocity of communication is S - L - O - W.

Very resp'y,

Headmouse

Visual Glide Slope Indication

Dear Headmouse:

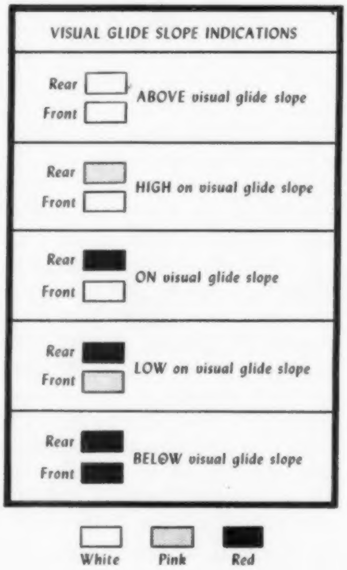
The cockpit cowling decal depicted below was recently suggested by Mr. John T. Miller for use with the Visual Approach Slope equipment now being used by FAA and several Air Force bases. It is suggested that it be considered for use in naval aircraft.

ANYMOUSE

► The label was evaluated and in its present form is considered unsatisfactory for use in naval aircraft. For day operations the decal would be acceptable; however, at night it would be unreadable with the red instrument and cockpit lighting presently used in naval aircraft. A modification to the label to include the color superimposed over the word description of the color in each rectangle would make it compatible for night flying and could be acceptable for Navy usage.

Very resp'y,

Headmouse



Lost Brakes

Dear Headmouse:

Re: "An Inch From Eternity" on page seven of the October issue, many carriers (CVA) in AirPac are using the open canopy as a means of telling the deck crew that the aircraft has no brakes. In light of the low level ejection capability, perhaps this procedure should be revised.

ANYMOUSE

► It has been my understanding that the signal for lost brakes is to drop the tailhook during daylight operations and turn on external lights at night. This procedure has been widely accepted on many carriers throughout the fleet although there is no mention of it in either NATOPS or NWP41(A).

All A-4 aircraft with service change 204 incorporated can now jettison the canopy from the open position so their low level ejection capability would not be impaired by using the open canopy as a signal for lost brakes. The A-4 involved in the article mentioned did not have ASC-204 so the pilot would have been unable to eject.

Very resp'y,

Headmouse

Have you a question? Send it to Headmouse, U.S. Naval Aviation Safety Center, Norfolk 11, Virginia. He'll do his best to help.

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Human Error Principles

In an effort to successfully reduce human error as one of the predominant cause factors in aircraft accidents, reference must be made to and guidance obtained from specific cases experienced, as well as basic principles of human behavior.

Ten principles, generalizations, or guides have been proposed for those attempting to understand the nature of the human error investigation process. These were formulated as the result of an evaluation of system test data from the ATLAS Program made by Rocketdyne.

The following 10 principles appeared in *AFSC Safety Newsletter* (Aug.-Sept. '63) and are well worth pursuing in the aviation safety program:

1. You can trust your knowledge of a human-initiated failure to the degree to which you are able to make a firsthand investigation of all the facts in the case. A corollary principal to this is that, upon investigation, a human factors engineer (i. e., a human error "detective") will usually see a problem quite differently than it is originally reported because his perspective (or what he is trained to look for) is different.

2. There usually is no one simple solution to human error problems; it is more typical to find that there are multiple corrective actions required. In tracing back the causes which led up to or permitted the error to occur, it is more typical to find that there are a series of branching preventive measures which are desirable to help preclude the recurrence of such difficulty.

3. Beware of general solutions to classes of problems. Dramatic solutions to big problems are rare and usually misleading. There is much more assurance of constructive action when specific problems are analyzed in a specific fashion and when sufficient effort is budgeted for follow-through to insure the attainment of a satisfactory remedy.

4. People do not always act as they are supposed to, as they have been instructed or directed, or as you might suppose that they would or should. Hence equipment and procedures have to be adapted (and readapted) to reduce or prevent the intrusion of unwanted human variability during periods of inadequate organizational control, work stress, and the typical operational handicaps which have to be expected on the basis of past experience.

5. Intelligent workers can beat any system of arbitrary or paperwork controls which might create some difficulty or unpleasantness for them or which seeks to impose upon them what they feel are unrealistic requirements.

6. A flood of previously unreported incidents could result as people hear more about human error, become sensitive to it, *and suffer no personal repercussions as a result of reporting it;* this new information could easily change the ascribed causes of some chronically recurring problems.

7. Avoid attempting to utilize figures-of-merit based upon human error to rate equipment items or attempting to use human error percentages as an index of workmanship, craftsmanship, or morale. Any comparative rating scheme will unfavorably influence opportunities to gain or evaluate information and will hinder negotiation for corrective action.

8. Superficial corrective action, such as the "notification of responsible supervision" or "reemphasis" of existing regulations, generally appears helpful in the absence of any other course of action. However, it should be recognized that habitual response of this type may be inadequate and that it sometimes does more harm than help.

9. Do not ignore minor, trifling, nuisance, or marginal problems. They often serve as fruitful leads to significant problems.

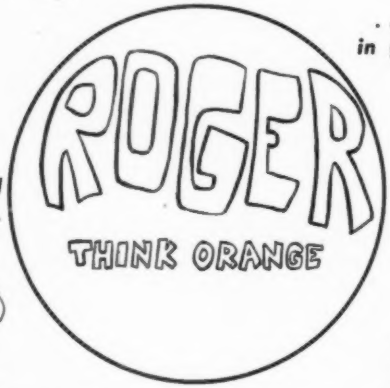
10. Direct observation of actual working conditions is critically important to determine the true nature of the situation under study, to locate significant unreported or unrecognized problems, and to determine what could be an effective remedy. Analysis, theory, logic, and hypothetical assumptions are *no substitute for direct observation.* (Italics supplied —Ed)

Safety is...

. . . a snug
hard hat

. . . a flight suit
in good condition.

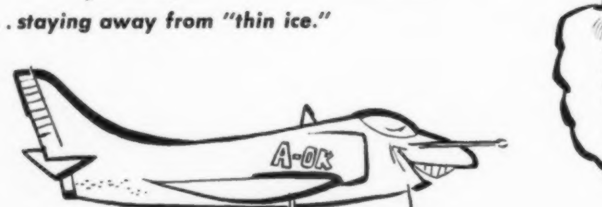
. oft



. . . a big orange ball
. . . named Roger.

. . . staying away from "thin ice."

. . . the mai nance
with a smile an
"up" thumb.



. . . an aircraft properly preflighted.

Thanks to Lt. J. A. Butterfield, VS-39 Aviation Safety Officer

. . . th n on

. . . mature judgment, sound and consistent.

. often confused with cowardice or "Old Lady" -ness.

. . . yes, YOU!

. . . headwork.

e maiance chief smile an humb.

. . . love of life, limb, family, service, and country.

. . . like the sea, unforgiving for negligence.

. . . the on the LSO's face.

MANUAL BAILOUT, from a Crusader? Sounds impossible — but it actually happened. To make it worse — that wasn't all of his troubles. . .

PASTRY TWIST

During aerial refueling of an F-8E on a trans-Pac flight, continued flow was indicated aboard the tanker after the aircraft had received a capacity load. There was a 3 to 4 foot fuel stream from the jet's tail. The pilot heard a loud pop. Observers saw the tail section enveloped in a cloud of raw fuel. Fuel poured from the left rear fin and out around the lip of the intake duct. Streaming a curtain of fuel, the F-8E lost power and began to drop back out of formation. "You are on fire," the wingman transmitted, "Eject!"

As the pilot got ready, his burning, barely controllable aircraft had descended to approximately 15,000 feet. Stick control was becoming less and less effective but there was no smoke, fumes or heat in the cockpit and no evidence of decompression.

Grasping the face curtain loops firmly, the pilot forcibly pulled until he could see the yellow flannel backing of the curtain and the loops were at the level of his chin. Nothing happened . . . the canopy did not jettison. He brushed the extended curtain back behind his helmet and pulled the alternate firing handle three times, extending the cable 4 to 5 inches . . . canopy still did not jettison. Grasping the emergency canopy release with his left hand, he pulled it to its full extent. Still the canopy would not jettison.

Leaving the handle dangling on its extended cable, he took hold of the canopy handle and manually unlocked the canopy which then jettisoned into the airstream. (*The pilot did not pull his canopy interruptor handle because he felt that the face curtain had been fully extended and thus was extended beyond the interruptor stop. He felt that pulling it again would be a waste of time.*) Still above 5000 ft, the pilot abandoned any attempt to eject after canopy removal and broadcast his decision to bail out manually. With his right hand he pulled the guillotine handle and began to position himself for bailout. The slipstream sucked out his left arm but he was able to forcibly retrieve it without injury. He did not

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disconnect his oxygen lines, leg restraints or any connections, but after the guillotine was activated, he was able to rise up in the seat without any binding. The seat had been adjusted to half-up position prior to flight.

Trimming the aircraft for a gentle left turn, he

put his left foot in the seat frame and his right foot on the instrument console. Raising up into the slipstream on the left side above the refueling probe, out he went. He was lifted out by the airstream, with no bumping, and cleared the aircraft. Estimated airspeed at the time was 220 knots and altitude at least 5000 ft. The flight was some 690 miles out at sea.

As the pilot left the aircraft, he concentrated on his D-ring, knowing that he must pull it for parachute action in a manual bailout. He vaguely recalls an approximate two-second period of silence before the D-ring was pulled. During this time he loosened his oxygen mask and flipped it to the left because the bailout bottle was not activated. Immediately he found he was unable to breathe.

To his surprise he had to reach above his left shoulder to grasp the D-ring. Aerodynamic forces operating during free fall had forced his horseshoe chute pack to a position 2 to 3 feet above and behind his head. He pulled the D-ring but felt no opening shock.

Looking up, he saw the chute pack about two feet above his head – the pilot chute half-in, half-out. He describes it as looking like a "mass of junk up there . . . like a bunch of dirty clothes sticking out of the parachute pack." He pulled the chute packing container to him by hauling on the risers and tried to tear the pack open. He did not grasp the canopy or shrouds. Suddenly the pack was jerked from his hands with a loud pop. The deceleration snapped him back down to the end of the chute risers. Looking up he saw the pilot chute open and the main canopy partially stream. Chute pack and backpad were gone. The tangled gores of the partially-open personnel chute were scalloped out, catching air with multiple loose and whipping shroudlines. About 12 tight shroudlines led approximately six feet down to his risers. His attempts to shake the main parachute canopy open with the shroudlines failed. The canopy looked to him like a "long pastry twist." It did not blossom out. Again he reached up and manipulated the taut shroudlines two or three times, but they snapped back when released.

The pilot was now below the cloud cover. He could see a large circle of calm water where his aircraft had gone in. His seat pack containing the PK-2 pararaft and survival equipment was still attached to him by the rocket jet attachment on the right. Down he rode his crippled, streaming chute to a point in the water about 200 feet from the plane splash.

He does not remember striking the water. His first recollection is that of hearing his Mk3-C life preserver inflate with a hissing sound and he realized he was still alive.

Pieces of aircraft floated about him and he saw his APH-5 helmet bobbing about 10 feet away. He thinks he retained the helmet during bailout and took it off just after surfacing but he is not sure. He believes he saw his PK-2 seat pack floating just under the surface of the water somewhat further away, but this memory is vague. His immediate feeling was that he was like a mass of jelly . . . detached and unreal. The impact had knocked out one of his lower molar fillings and loosened two others which later fell out.

Still feeling detached and unreal, he watched as his shroudlines gradually entangled him by sea action, but finally he released his upper rocket jet fasteners without difficulty. He cut away the shrouds with his survival knife; it did the job easily though he had considered it dull. He did not deploy dye marker but did attempt to ignite a distress signal. Both daysmoke and night ends fizzled briefly and then failed. At this point he discarded his gloves which had become slippery in the water. He had lost his service revolver and tracer ammunition on impact.

Water temperature in the area was about 65° F. and sea state was Four during the 2¼ hour period before rescue. An orbiting KC-130 dropped dye marker in the water and a raft which was lost because of apparent failure to inflate. An *Albatross* arrived after 45 minutes and dropped two rafts. The first landed and inflated 100 yards from the survivor. The second, dropped 30 minutes later, trailed its lanyard 20 feet from him and he was able to draw it to him. During the remaining hour that he was in the water, he hung on to the side of the raft. He tried to board it numerous times but failed.

The first vessel at the scene was a minesweeper which dispatched a diver in a wet suit to his assistance. He was pulled aboard by means of a rope looped under his arms.

Recuperating in the hospital from injuries which medical personnel believe occurred as he struck the water – a fractured vertebra, broken ankles and a broken pelvis – the pilot was quoted by a reporter, "This business of your whole life flashing before you is baloney, at least in my case. I was too busy for that."

PANIC!

HOW will you react when faced with a sudden in-flight emergency? Will your mouth turn dry? Will you choke up?

Probably. But the important thing is, will you do your job? Aircraft commander, flight attendant, scanner, engineer, navigator—regardless of your crew position—teamwork is vital. No coordinated action required will be any stronger than the weakest member of the team.

Lack of crew coordination and panic during a recent inflight emergency resulted in an unnecessary and improperly executed bailout and cost another command the lives of seven crewmembers. The alarm bell was never rung. Confusion, noise and shouting filled the crew compartment. The aircraft commander recalls that the only distinguishable voice was that of a crew member screaming, "This damn thing is coming apart."

Panic reigned supreme.

The crewmembers who lost their lives in this case bailed out over the Arctic, but left their necessary survival equipment aboard the aircraft.

How successfully you survive an emergency can depend largely on how well you carry out your assigned job. And, how well you carry out your job is related to how well you know your emergency procedures and how frequently your team runs through drills. History has shown that well-trained and drilled crewmen carry out their tasks instinctively when faced with emergency situations, even when suffering from great personal stress at the time.

Panic and ignorance run hand in hand. Since your own life, as well as the lives of fellow crewmembers and passengers can depend upon your carrying out your duties in an emergency, it is vitally important to know a few basic principles of avoiding panic.

- Know the limitations and capabilities of your equipment.
- Know how to use your equipment.
- Avail yourself of indoctrination and training.
- Drill in emergency procedures to maintain constant proficiency.
- Maintain physical fitness and mental alertness.

Pressures inherent in emergency situations breed confusion and distraction. Panic, too, is a very real hazard in any such situation and when in charge will defeat procedures which have been developed to successfully combat foreseeable emergencies. Panic must be recognized for the hazard it is. To combat it, the best weapon is common sense based on training and experience.

An emergency in itself is not a catastrophe. To be unprepared is.

For the well-trained and drilled airman panic is no problem, and survival is no accident.

—5th AF Safety News

BEWARE OF PROPS

Men who work on flight decks are very much aware that collisions between people and whirling props are likely to be more injurious to the people than the hardware.

Prop accidents on the flight deck have increased in recent years. During calendar 1962 and 1963, seven men engaged in flight deck operations were fatally injured by propellers. Eight others sustained non-fatal injuries. (Moving propellers present just as great a hazard on airfields. However, there have been no non-flight-deck prop injuries in the Navy since 1959.)

Who were the men injured and killed by props in this two-year period?

As would be expected, most of the victims were blue shirts assigned to carriers' V-1 divisions. Because their duties require their presence on the flight deck, these men are continually exposed to all the dangers and hazards associated with flight deck operations. One flight deck director was fatally injured and two naval aviators were struck but not killed. (One of the pilots undoubtedly owes his life to the fact that he was wearing his hard hat.)

When did most of these accidents take place?

Only four of the 15 occurrences, three non-fatal and one fatal, took place during daylight hours. A fifth happened at dusk and the rest at night.

What part did degree of training and experience play in prop injuries?

This, of course, is a difficult question to answer from the accident reports alone. However, the listing below shows the accident potential of inexperienced men working on flight decks. And, considering the long experience of some of the victims, you can conclude that the flight deck is a dangerous place no matter what your experience level.

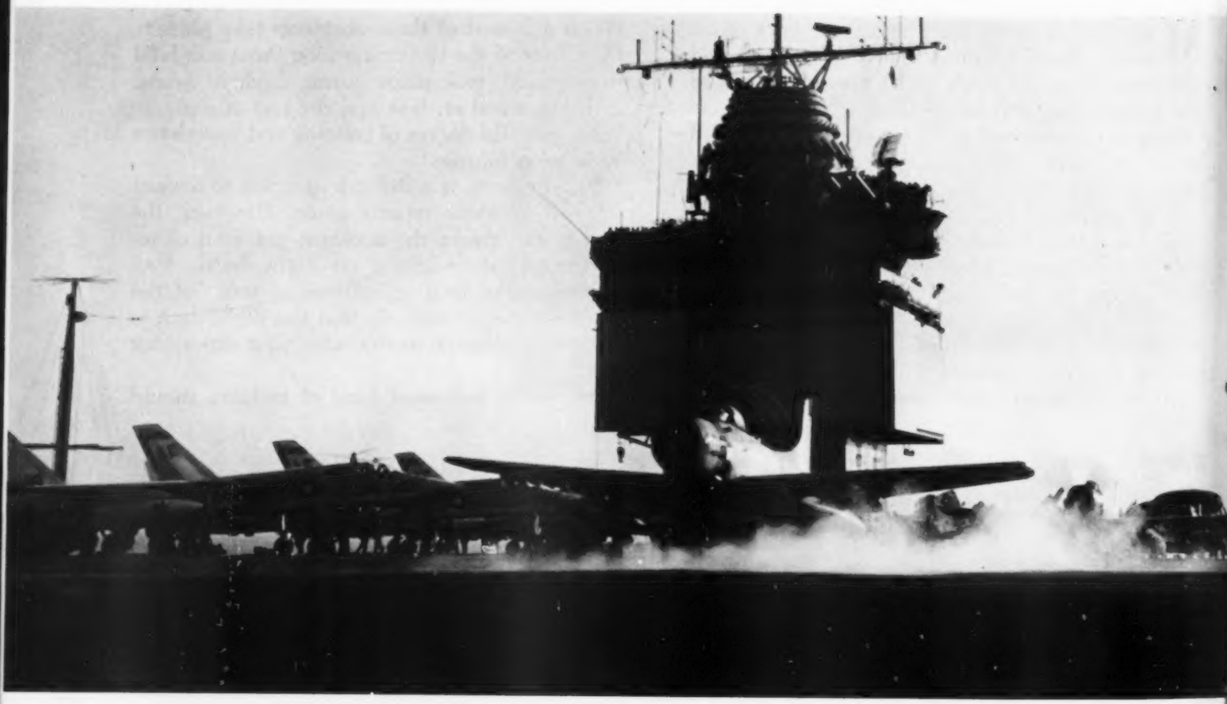
How much and what kind of training should be given men newly-assigned to the flight deck?

No one can flatly state how many hours, days or months it takes to train an individual to the point where he can do his job on the flight deck safely and well. This is an area in which supervision and the supervisor's evaluation of the trainee are extremely important.

Ideally flight-deck training covers the following points:

Chart I

Experience Reported	Injury	Time
8 days in V-1, third day actual flight deck operations	Severe	Night
NC-2 driver, fifth day of driving	Fatal	Dusk
9 days, first night on deck	Serious	Night
14 days as plane captain, first week of nights	Fatal	Night
21 days	Fatal	Night
25 days	Serious	Day
1 to 1½ months in V-1, 32 hours of night deck operations	Fatal	Night
2 months in V-1	Critical	Day
5 months previous experience, first day on deck after 2 months TAD	Critical	Night
18 months	Fatal	Night
Flight deck director	Fatal	Night
Naval aviator	Minor	Day
Naval aviator	Critical	Night
Not reported	Moderate	Night
Not reported	Fatal	Day



• Complete explanation and briefing on accident potential existing when working in close proximity of aircraft.

• Buddy system of on-the-job training for flight deck operations, day check-out first.

• Close supervision of individual for a short period of time after being qualified to work alone on the flight deck. Day check-out first.

• Predetermined period of time for working on flight deck prior to being assigned to night flight deck operations, depending upon advancement or response of individual concerned.

• Repeat of steps two and three for nights.

What were the accident-producing factors in these prop injuries?

Negligence, inattention or lack of awareness were the reported causes of almost every propeller injury. However, there are oftentimes other factors to be considered.

Fatigue: To attempt to prove that fatigue is a primary causal factor in any aviation mishap is almost impossible. Most persons will agree that long hours on duty, whether spent in actual work or not, reduce performance and overall alertness. This is very evident on carrier flight decks during night operations. In spite of attempts to operate with split crews during intensive operations, it is not uncommon to find persons required to work 14 to 16 hours a day. Fatigue is present to some extent during all night operations. A number of prop injuries have occurred during parking and securing aircraft following recoveries late at night. Any effort to reduce the number of hours flight deck personnel are required to spend on the flight deck is a step in the right direction.

Vision problems: The advent of red floodlighting carrier flight decks has been a boon to night flight deck operations but, according to comments on the prop injury reports, it has not solved the problem of prop visibility. ". . . Red floodlights on the island structure, although assisting detection of static or relatively slow-moving objects by silhouette, tend to decrease the opportunity to detect a spinning propeller due to their glare." ". . . Visibility of rotating propellers . . . is not increased proportionately to stationary objects, and propellers remain extremely difficult to see."

In addition to lowering visibility, depth perception decreases at night and makes judgment of speed and distance more difficult. It is not only

The Big Blades

From the Flight Safety Foundation in New York come the following comments on the treatment of prop aircraft by mechanics and others coming into contact with propellers:

- Never, under any circumstances, walk through the arc of a propeller.
- Treat every propeller as though the engine was running or was being started.
- Watch where you are going, of course, but do not trust a quick or sidelong glance. In some lights and at certain angles, especially at night, a whirling propeller can appear to be standing still.
- Make it an unfailing habit to stay safely beyond the reach of the big blades.

what but also *where* and *how far away* is the danger. Several of the prop injury reports discuss the value of having all flight deck personnel undergo a formal course of night vision instruction.

In a number of the accidents, the victim was known to have poor eyesight but was not wearing his glasses at the time. For instance, in one fatal accident, the man had 20/50 vision in both eyes without glasses; he did not have his glasses on when struck by the prop.

On some carriers, a thorough eye examination is required before a person is assigned to work on the flight deck. Personnel whose vision is substandard should have it corrected to a minimum of 20/20 and should be required to wear their glasses. Such examination should emphasize depth perception.

Hearing: Many of the prop victims were wearing sound attenuators or Mickey Mouse helmets. Although wearing sound attenuators is necessary and advisable, flight deck personnel should be advised of the marked change in ability to hear when wearing this device.

An individual working on the flight deck must depend on his sense of sight for personal safety rather than his sense of hearing. Attenuation of sound reduces a person's ability to localize sounds. Since hearing is a sense which man is accustomed to using as an alert device, a program of reeducation is called for.

Sense of balance: Vertigo can occur on a dark flight deck when no visual horizon exists as it can occur in the cockpit in flight. When a person's body is in rotation with the carrier, as in a sharp turn, and he moves his head voluntarily out of the plane of rotation, vertigo can result. The motion is strongest when head movement is at right angles to the plane of rotation, for instance, in looking down and back over the shoulder. Theoretically, someone experiencing this kind of vertigo on the flight deck could lose his balance and fall into a spinning prop.

The following recommendations are offered as a means of implementing training of flight deck personnel and decreasing the number of propeller injuries:

- Establish a training program stressing both safe and dangerous positions and practices around each model aircraft, with demonstrations of common mistakes that are made.
- Require that all personnel who work on the flight deck have:
  1. Unaided visual acuity not less than 20/100 in each eye. If visual acuity is less than 20/30 in either eye, vision should be corrected to 20/20 in each eye with corrective glasses worn at all times.
  2. Normal depth perception.
  3. Normal color perception.
  4. Night vision training prior to assignment.
- That no one disembark from aircraft onto flight deck until the aircraft is chocked, with tiedowns on and engine(s) cut.
- That the flight deck director not leave the aircraft he has just parked until the engine(s) are cut.
- That every effort be made to discourage personnel from walking through the area of propeller arcs when propellers are stopped since this establishes a dangerous and potentially lethal habit pattern.
- That all carriers prepare a formal ship's instruction incorporating under one cover the entire indoctrination and reindoctrination training program for flight deck personnel.
- That efforts be directed to standardizing flight deck procedures, by carrier types similar to the NATOPS Manuals.

DAMAGED RAFT

CREWMEMBERS of a transport that was ditched off shore spent an uncomfortable half-night in water up to their waists in their Mk-20 life raft. The CO_2 inflation tube had ripped loose from one of the inflation chambers of the raft. CO_2 escaped through the hole and air leaked out as fast as it was pumped in. (*Immediately after raft inflation, you should always clamp off the equalizer tube. In this case doing so would have isolated the one good chamber of the raft, thus obtaining satisfactory inflation. — Ed.*)

The men changed the pump to one of the other pumping points to try to find another compartment which would be airtight. They managed to inflate the boarding station which was enough to keep the raft afloat. The pump was then switched to still another point, probably to the other main chamber, which partially inflated. The crewmen pumped through the night to keep the raft afloat.

As the raft became more buoyant, one by one the survivors climbed aboard. The last man was in the raft three hours after the ditching. They were picked up by a small boat from an AKS shortly before 0100.

Among the AAR's recommendations were:

- That additional and recurring training be given in the proper use of all survival equipment provided in assigned aircraft.
- That survival equipment remain secured until the aircraft comes to rest to preclude injury from loose gear.
- That the flight manual and/or the NATOPS Manual establish in the emergency section that the raft not be inflated until it is a sufficient distance away from the aircraft to ensure that it is not damaged during inflation.

Visible Wire

IT was reported that during a life vest inspection, one smoke flare was discovered in which the wire to the match starter was visible and needed only slight movement to ignite. More individual attention to preflighting the life vest is indicated.

—Aviation Safety Council

Exit Pilot

AFTER the aircraft had come to a halt following an uncontrolled landing, the pilot attempted to release his restraint harness. He stated later that he felt as though he were "in the arms of an octopus." He disconnected his oxygen hose and radio jacks *which were entangled in a camera which he had around his neck.* (Italics supplied—Ed.) He then began to

NOTES FROM YOUR FLIGHT SURGEON

unfasten the rocket jet fittings. So frantic were his efforts that he stated he depressed one release device and then moved to another without assuring himself that he had completely released the first fitting.

After releasing his shoulder fittings he attempted to stand, then realized his lap fittings were secured . . . released these and mistakenly pushed his inertia reel lock handle . . . again stood and realized his leg restraints were secured . . . sat down again and released his leg restraints. Finally, leaping from the aircraft, he parted his emergency oxygen hose which he had not disconnected.

Fatal Slip

A GROUP of flight line personnel were assigned the duty of washing the wings of a C-54. For a work platform, two of the men were using a pallet held in the extended position 15 feet above ground by a fork lift. The driver maintained the position of the fork lift by depressing the clutch and leaving it in reverse gear and applying the foot brake as necessary. His foot slipped off of the depressed clutch causing the vehicle to lurch forward. One of the men lost his balance and fell from the pallet. He grabbed the leading edge of the wing but slipped and struck the ground on his head. He never regained consciousness.

Combining to produce the accident were haste to finish the job in order to secure . . . lack of safety devices . . . use of a forklift instead of a stable stand . . . an unqualified driver operating a fork lift in an unauthorized manner . . . poor judgment on the part of the work party and a lack of supervision.

Human Error

TWO ground crewmen with a verbal order to change the drop tank on the starboard side of an A-4C asked the ordnance crew if it was *OK* to remove the tank. The ordnance crew replied affirmative. The ground crewmen assumed this meant that the drop tank was empty. In reality, it meant that the ejector cartridges had been removed and the ordnanceman would release the suspension hooks when the ground crewmen were ready, this being the only responsibility of the ordnance crew.

One ground crewman put his right hip below the tank and his right arm around the nose. The second ground crewman grabbed the rear end of the tank. The tank was partly full and weighed between 500 and 600 lbs. It slipped from the second man's hands and fell with the first man to the ground. His leg was broken.

The investigating flight surgeon reports that in other squadrons there have been similar accidents though they did not involve injury. Lack of supervision was considered a factor.

Solar Still

A PILOT setting up housekeeping in his raft after ejection and descent to the water put his solar still in operation. Orbiting aircraft and the search destroyer reported that the still was highly visible and a definite aid in locating the survivor and keeping his position spotted.

The pilot reported that the plastic packet which the still comes packed in is by far the best container to use to fill the still. Even in a fairly smooth sea, he says, it is a job to pour water in the little hole in the top of the still.

Jettisons Mask

THE pilot did not actuate his emergency oxygen supply prior to ejection in a standard seat. Thus, when he was coming down in his parachute, his A-13A oxygen mask made him feel as if he were suffocating. Instead of pulling the green apple in the seat pan, he discarded the mask which fell away and was lost . . . an important piece of gear which might have protected him from the facial injuries which he sustained on landing.

—From an MOR

Panic Delayed Exit

AFTER an SP-2E swerved off the runway on takeoff and slid on its nose to a stop, the crew evacuated the aircraft. As soon as the plane came to a halt, the ordnanceman released his lap belt and went to the afterstation. In restrospect he is not quite sure why he did this — perhaps to check for fires. (There was some incendiary gear in the afterstation.) However, once there, he made no specific checks but instead, absent-mindedly removed his hard hat, mae west and parachute harness. He was in the process of stowing these items in his flight bag when suddenly it dawned on him that he was the last man in the aircraft and that there was no telling just what was going to happen. He had flashing thoughts of the aircraft rolling over, exploding, . . .

At this point he exited the aircraft in a mild state of panic, injuring himself slightly as he went out the port afterstation window feet first. He hung from the edge for a moment, dropped 10 feet to the ground, scrambled to his feet and ran to safety.

There's more to goof-proofing than meets the eye. Most human errors only appear to have simple causations and simple remedies. A closer look reveals the need for better mishap analysis before we can approach the solutions.

76

Maintenance Goofs

Although fewer maintenance errors were reported (76 as against 101), the dollar cost for the first quarter FY 64 exceeded that of the previous quarter.

Once again the lack of a cotter pin caused an accident that resulted in overhaul damage . . . an old story repeated over again. Strut servicing errors continued to plague us this quarter and caused a carrier accident and overhaul damage. Meticulous attention in this area continues to be the only satisfactory answer to this problem.

Everyone associated with the maintenance and servicing of aircraft should study these errors and make a positive effort to prevent repetition.

More than two-thirds of the reported goofs involved aircraft damage or personal injury. Note breakdown below. All 76 incidents are briefed on the following pages.

Aircraft Damage	1st Qtr FY 64	4th Qtr FY 63
Strike	2	2
Overhaul	3	2
Substantial	2	5
Minor	6	19
Limited	40	40
Estimated Loss	$2,400,730	$1,906,390
Personal Injuries		
Fatal	0	3
Critical	0	1
Serious	0	4
Minor	5	5
Personnel errors involved in aircraft accidents	7	6

The human factor is especially evident in aircraft maintenance practices. Currently one accident out of every twelve in the U. S. Navy has, as a primary or contributing factor, maintenance error.

Fault here is two-fold. The most immediate and the most easily recognized problem area is supervision. Supervision ranges from the basic task of looking over the shoulder of a worker to proper recognition by the higher echelons of the problems in training, programming and management. But, through all phases, supervision is a leadership assignment and success can be attained only by constant attention and vigilance. Responsibility and authority go hand-in-hand and both must be vigorously exercised at all levels to achieve our goals.

However, supervision to reduce complacency and supervision to counter-act the harmful effects of overconfidence are only part of the answer. Increased efforts must be made to reduce the human factor before the aircraft gets to the operational stage. Here is where we find a sharp division between reliability and safety.

—Rear Admiral Edward C. Outlaw, Commander Naval Aviation Safety Center, International Air Safety Seminar, Athens, Greece, Nov. 1963

A-5

1. Improper installation of a parallel servo amplifier caused a flight control system malfunction; F damage.
2. Improper installation of the internal stores ejection breech resulted in E damage.

A-4

1. An improperly servicing MLG strut (inadequate fluid) resulted in overhaul damage.
2. Failure to properly secure the oil cap cover resulted in D damage.
3.-4. Overtightening of the rack sway braces resulted in loss of the fuel drop tanks.
5. Crewman neglected to man the cockpit while using GTC to raise the flaps; fire; E damage.
6. Improperly routing a brake line on the strut resulted in one airplane receiving class E damage and one D damage.
7. Failures to tighten a bolt and to remove obsolete parts as secured by a service change resulted in D damage.
8. Improper installation of AMC-262, amendment one and using a larger ground off bolt resulted in loss of bomb.
9. Failures to secure and inspect radome fasteners resulted in E damage.
10. Failure to lockwire an oil drain line cap resulted in engine overhaul.
11. An attempt to drop check the nose gear after filling the strut full of fluid caused D damage.

F-1

1. External fuel tank was lost due to overtorque of the front post support lever bolt.

F-3

1. Failure to lubricate a wheel bearing during check resulted in loss of the wheel; E damage.
2. Failure to replace a damaged cockpit air duct resulted in a fogged windscreen causing E damage during landing.

F-4

1. A main tire was overinflated and exploded due to the use of a faulty tire gage. A regulator handle was missing from the HP air compressor; two minor injuries.
2. Stray hardware jammed the stabilizer control rod during flight; no damage.
3. The crew failed to install the drop tank safety pins; two tanks jettisoned/damaged.
4. Failure to properly assemble exhaust duct track with liner support resulted in vibrations in flight.

Please turn page

5. Crew failed to install the ground safety pin in the port rack during a stray voltage check; E damage.
6. Improper installation of the drag chute handle prevented the use of the drag chute; F damage.

F-8

1. Failure to install a cotter pin in the landing gear actuator nut and bolt resulted in overhaul damage.
2. Misrigging of the fuel master switch, ASC-316, resulted in flameout; strike damage.
3. Improper security of the electronic access door resulted in inflight loss of door and E damage.
4. The crew failed to man fuel vent stations during refueling; overpressurized tank, D damage.
5. Crew allowed drain fuel to accumulate and to become ignited by the exhaust; E damage.
6. Starting access panel was lost inflight due to failure to engage fasteners.
7. Failure to remove inlet duct plug from inside duct resulted in FOD engine change.

F-9

1. Improper rigging/adjustment of MLG door resulted in E damage.

F-11

1. Crew failed to properly secure all engine access door fasteners; E damage.
2. Improper adjustment of MLG microswitch resulted in E damage.

T-2A

1. Failure to lubricate landing gear bearings resulted in a wheels-up landing and D damage.

A-1

1. Failure to install a cotter pin in the throttle control linkage nut and bolt resulted in E damage.
2. Attempt to jack up an airplane which was tied down resulted in D damage.
3. Failure to determine the cause for black exhaust smoke and to correct the discrepancy resulted in overhaul damage.
4. A cross-threaded and overtorqued spark plug caused engine failure; C damage.
5. Improper adjustment of the aileron boost cylinder operating mechanism caused an aborted flight.
6. Failure to install ground safety pins and placing a helmet over the "T" handle resulted in ejection of two fuel tanks.

C-117D

1. An attempt to replace the clevis bolt in the MLG tie rod without the use of a spreader bar or jacks resulted in severe injury to a mechanic.
2. Failure to properly inventory tools after performing maintenance resulted in engine FOD and E damage.

C-130

1. Failure to properly secure the ATM cover plate resulted in E damage.

P-3

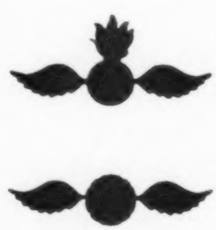
1. Failure to properly secure the propeller afterbody door resulted in loss of prop control; F damage.
2. Improper adjustments of the propeller feather /unfeather system resulted in an overspeed.

P-2

1. Leaving stray elastic stop nuts in the landing gear caused a gear malfunction; F damage.
2. Failure to properly secure and inspect the radioman's escape hatch fasteners resulted in E damage.
3. Improper installation of an electrical lead to the throttle actuator caused a flameout and prevented a relight.
4. The life raft door fell off during runway turnup due to improper installation. It was reinstalled so that it could not be actuated if it had been needed; E damage.

C-54

1. A failure to lubricate a wing fairing door bearing resulted in E damage.
2. The crew failed to reset brakes and allowed the aircraft to jump the chocks; E damage.



3. Failure to tighten the oil line fitting on propeller governor resulted in an aborted flight.

S2/C-1A

1. The crew failed to tighten the carburetor inlet hose B-nut; C damage fire.
2. Improper adjustment of the radome position indicator microswitch and bracket resulted in E damage.
3. Crew improperly assembled the propeller feather switch which caused it to malfunction; F damage.
4. Improper alignment of the winglock four-way valve button and cam following pin resulted in premature extension of locking pins; D damage.
5. Connecting a hydraulic line 90 degrees from its proper position on the nose gear actuating cylinder resulted in loss of hydraulic fluid and E damage.
6. Avionic access hatch lost inflight due to failure to engage fastners.

EC-121K

1. 2. On two occasions failure to replace overage oil hose resulted in loss of oil and temporary loss of engines.
3. Installing a hydraulic wiper upside-down and adding an O-ring in the nose steering control valve caused a malfunction; F damage.

U-11A

1. A mechanic allowed an airplane to roll forward and strike another airplane; C and E damage.

UH-2A

1. Improper routing/installation of a fuel bypass tube caused the tube to break and resulted in engine failure and strike damage.

SH-3A

1. The crew failed to properly lock/inspect engine door hooks; E damage.
2. An attempt to check the controls during turn-up while a servo control rod was disconnected resulted in E damage.
3. Failure to properly secure all engine access door fasteners resulted in loss of the door; E damage.
4. Failure to properly tighten the sunshield and OAT gage probe resulted in engine FOD; E damage.

H-34

1. Air intake screen was lost inflight due to improper security and inspection.
2. Improper installation of contravane cover plates allowed the components to come loose and cause D damage.
3. A rotor blade was dropped on the side of the helicopter causing E damage.
4. Reusing a faulty self-locking nut or failure to tighten the nut on the air intake door rod caused an aborted flight.
5. Failure to coordinate the folding of the blades and bleeding the rotor brake system resulted in E damage.
6. While servicing new dampers a rotor blade was dropped causing E damage.
7. Erroneously lockwiring a blade horn locking pin in the OUT position resulted in E damage.
8. Failure to properly engage the emergency door release pins resulted in loss of the door; E damage.

UH-25B

1. Failure to replace a dead battery contributed to a quick engagement and E damage.

SHU-16C

1. A supervisor assigned an inexperienced crew to drop check a landing gear strut. A failure to properly service the strut resulted in E damage.

Please turn page

WHAT'S WRONG

with this fitting? See next page —

Chief Aviation Electronics Technician Hugh Brainard of NAS Alamitos says we went way out to include ATs in the last quarterly report (Feb. "101 Maintenance Goofs.") And, that we didn't go far enough to include those cases in which the AT comes under suspicion yet charged to pilot error. So, he has furnished a few to make his point and to impress upon this rating group their responsibilities to aviation safety. Just because communications with St. Peter is one way and witnesses can't testify the AT appears to be innocent. Point the finger where the hurt is, he says. Here's why:

1. Contact with the ground during IFR approach. Suspect the pilot was trying to manually set up a frequency that should have been on button no. 3 but wasn't.

2. Contact with the ground during an ILS approach at an Air Force or civilian alternate. Suspect Glide Slope. Found the parent station's maintenance attitude to be: "They never use it, it's an Air Force gimmick."

3. Midair collision during a very erratic holding pattern. Suspect failure of the two birddogs, the two omnis and the one tacan to agree within the tolerated but very lenient 3 degrees. Also contributing was the fact that the approach controller's advice that other traffic was present was never received. Suspect a weak receiver that had functioned tolerably, straight and level, enroute, but could not hack it with a little aircraft shielding in the standard rate turn.

4. Contact with the water during night ASW. Suspect: (a) RadAlt limit light out or, (b) limit-set knob missing with limit bug at 1500 feet.

5. Ditched P-2 in 34°F water 30 miles from a freighter. Freighter was not observed because radar had finally given up. Mag current had been griped as fluctuating the three previous hops. (Some witnesses were thawed out on this one.)

The point is that while a pilot might still have control of his bird with an AT-induced malfunction, he may have other uncomfortable things to think about at the same time such as low fuel state, no. 1 feathered, zero hydraulic pressure and so on. The effects of such a malfunction on an already agitated state of mind could be disastrous — to the fatigued jet-jockey on a 200-knot IFR approach, with his eyes on the manual tuning dials, it could be *fatal*.

The chief states that he'd like to see a study made along these lines. So would we. Incomplete reports preclude such a study at this time.

If it were possible, a goodly number of mishaps now listed as undetermined or material failure would be recategorized maintenance error. It is agreed that we need to take a fresh look at that very intangible factor — human error in production, overhaul and maintenance. What is human error? It may be defined as, "Any deviation from a previously established, required or expected standard of human performance that results in an unwanted or undesirable time delay, difficulty, problem, incident, malfunction or failure."

Too often conclusions following investigation of mishaps are given the wide brush treatment and labeled "carelessness" on the part of the individual involved. Moreover, human errors are often purposely concealed in order to avoid placing the blame for a failure on a particular individual. What is needed is a means of analyzing and reporting occurrences of human error in such a way that the cause will not be assigned to the person, but rather to his interaction with the system.

The Center with its vast storehouse of statistics and facts can tell you what happened, and what damage or injury resulted.

Answer to question on page 39.

But these are only symptoms.

You on the scene hold the answer to *why* it happened. Your investigation into that why, especially from a human factors standpoint, will pave the way for your on-the-spot prevention.

To be effective, investigations should consider the mechanic as a person, not a cog in a great machine. He is an individaul, subject to emotional, spiritual, intellectual as well as physiological forces which determine the character of his work.

With these considerations in mind, human errors can be classified so that more effective steps can be taken to prevent them. One method is to prepare statistical summaries of human errors in the same way that statistics are completed on mechanical malfunctions. This is expected to uncover such critical areas and aid in the development of solutions to the human error problem.

One such classification, based on experiences of the missile industry, may be helpful in the investigative process, is the checklist appearing on the next page.

Safety in aviation depends on the skill, intelligence and integrity of the mechanic. Skill and intelligence is not enough. A good safecracker has those qualities. Unless these are combined with integrity these may be wasted. Integrity in aircraft maintenance includes:

1. An awareness not to undertake a job for which the person is not qualified and competent, and the guts to admit this to a supervisor. This should be possible without adverse effects on the technician's status.

It can be stated succinctly "When in Doubt — Don't."

2. Another aspect of integrity is to take nothing for granted. Don't "assume" what a manual says — read it! Check and double check, invite inspection, be proud of ability to hold up under inspection.

3. Responsibility to communicate. Integrity requires the man to be sure that his successor is adequately informed of the status of the work which is left to him to finish. To trust that the next shift will be able to finish up a job without briefing will inevitably result in trouble and possibly disaster. Communication also includes a willingness to admit mistakes (but this need not be followed by punishment).

WHY IS IT? SOME AVIATION RATINGS ARE TAGGED FOR MAINTENANCE ERRORS REGULARLY WHILE OTHERS MANAGE TO KEEP THEIR SKIVVY SHIRT TAILS CLEAN.

Human Error Checklist

Manning

Insufficient number of personnel
Wrong personnel assigned

Workmanship

Improper installation of an item
Failure to install an item, or incomplete operation
Installation of a wrong item
Poor quality workmanship
General manipulative ability
Incorrect adjustment, calibration

Communications, verbal and written, excluding formal documents (including feedback)

Information received only partially correct or late
Incorrect information received, supplied, or used
Information received not understood
Insufficient information received, supplied or used
Garbled information
Too much information, or overload
Insufficient communication facilities

Supervision and Administration

Wrong instructions given
No instructions given
Failure to provide necessary and/or adequate items (logistics)
Inadequate supervision

Handling and Procedures

Failure to follow prescribed procedures, blueprints, specs, wrong tools.
Prescribed procedures inadequate wrong tools specified, inadequate, or missing labeling and coding.)
Inattention in handling
Failure to follow procedures in handling
Inadequate procedures in handling
Gross movement neglect
Inspection error
Imposes hazard to personnel or equipment.

Behavioral Efficiency

Fatigue	Intelligence
Stress	Alertness
Attitude	Sleep
Motivation	Drugs

Engineering or design inadequacy

Insufficient facilities
Insufficient or inadequate equipment, or controls
Arrangement of equipment, or controls
Arrangement or design of display, or displays

Environmental (contributing to human error) — Excessive or inadequate

Temperature Humidity Moisture
Atmosphere (toxic or noxious)
Noise, Lightning, Vibration
Workspace (and accessibility)

Control Design

Excessive force required
Excessive rate of response required
Excessive reach required
Excessive number of responses required (overload)
Poor arrangement of control, reach location, operator position
Configuration of control
Incorrect operation of control

PROFIT BY THE MISTAKES OF OTHERS — A recap of 347 maintenance goofs occurring in Fiscal '63 is now being printed, and will be distributed to your safety officer in May.

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Static Ground Connections

To ground or not to ground.

Although the existence of static electricity is readily accepted, its potential under certain environmental conditions is often overlooked. Most of us think of static electricity as the tingling sensation we experience after sliding out of a car then touching the door handle or the time we started to shake hands with another person and sparks flew. Yet, many fires and accidents have been caused by these seemingly harmless little sparks.

Static Electricity Creation

Static electricity is usually generated when two dissimilar materials rub together. In flight, it can be caused by ice crystals, precipitation particles, sloshing fuel, or the charged particles in hot exhaust gases. On the ground, it can be built up by blowing sand, dust, snow, or smoke. Since there is little control over the causes of static electricity, means must provide for dissipating these charges as they accumulate. Two requisites for bleeding off this static electricty from parked aircraft are good static ground points on the aircraft, and satisfactory ground points in the ramp or parking area.

Aircraft Static Ground Points

Static ground cables should be attached to aircraft at the designated locations. Normally, specific ground connections are given for all aircraft.

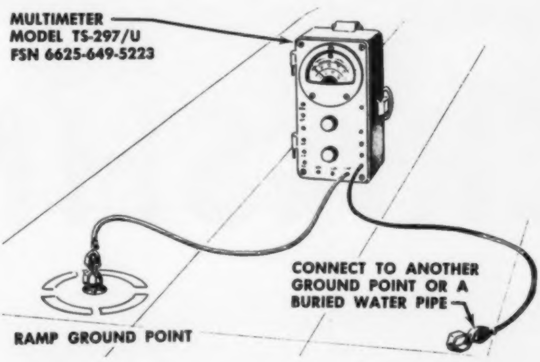
Aircraft static ground points should be checked frequently. Keeping the grounding surfaces free of oil, grease, paint, and other insulating materials insures better grounding conditions. Badly worn ground braid should be replaced.

Periodic resistance checks should be made of all aircraft ground points. In no case should the resistance exceed 1.0 ohm. Resistance checks can be accomplished with a multimeter.

Ramp or Parking Area Static Ground Points

Ramp or parking area ground points need to be properly maintained to assure adequate bleedoff of static electricity from the aircraft. It is important that ground points be checked frequently to determine the amount of resistance. In order to discharge static electricity from aircraft, a ground point with less than 10,000 ohms resistance is preferred, but the resistance must be less than 100,000 ohms. Normally, where the ground rod extends below the ramp into moist soil, a resistance of approximately one ohm will exist.

The resistance between ramp ground points can be checked with the method shown.



A. Set the multimeter to read resistance.
B. Connect the circuit as shown.
C. Read the resistance of the circuit in ohms.
D. Divide the reading by two to obtain the average resistance of the ground points.

It is always best to have adequate braid to reach a good ground point. An extra few feet of braid will provide a negligible amount of resistance for bleeding off static electricity.

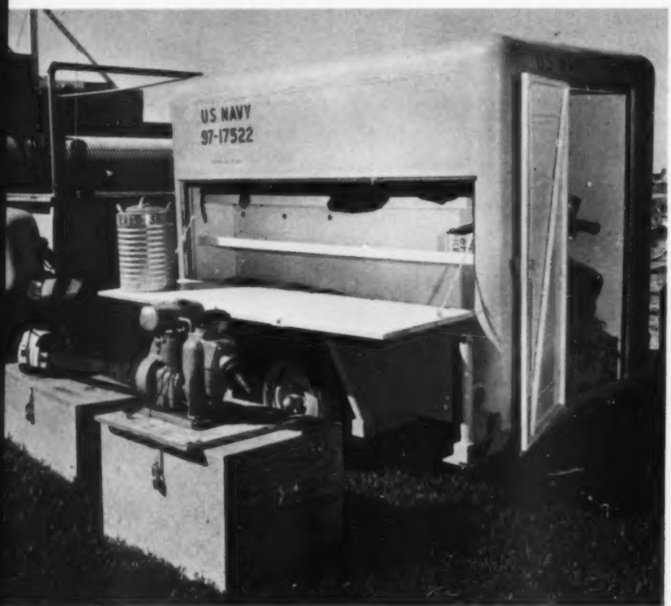
It is always best to connect the static ground lead to the aircraft first and then connect the other end to the ramp ground point. This will keep possible sparks, as a result of static electricity buildup in the aircraft, at the ramp ground point rather than at the airplane.

Attention should be given also to static ground of large pieces of maintenance and fuel handling equipment. The potential of static electricity between the aircraft and equipment can be equalized by connecting a ground braid between the aircraft and ground support equipment.

—*Boeing Service News*

NAS Lemoore

CRASHMOBILE

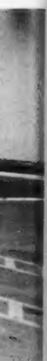


A CRASH and salvage expedition into the Sierra Mountains led to the development of a ready trailer by NAS Lemoore.

The mission called for crash investigation and salvage of an aircraft at a 7000-foot elevation This provided an excellent opportunity to determine from experience the equipment requirements. The crash site was a crater 25 feet in diameter, 10 feet deep with about 3 feet of water and located about 300 yards off a dirt road in a dense stand of tamarack pines. Considerable time was needed to locate camping gear, tools, food and rolling stock.

Engine recovery required digging to the bottom of the crater. The county road department did the digging with a clam bucket crane, a chain saw was borrowed to cut trees to move equipment in. Forest Rangers loaned a pump to pump the water out. The complete operation was a result of coordinated effort on the part of many people including the Sheriff's Department, County Road Department, Forest Rangers, Agriculture Department, local residents and the military.

An attempt to convert an ordnance trailer



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Inventory of Salvage Trailer

10	Sleeping Bags	1	Short Handled Shovel
10	Sleeping Bag Liners	10	Small Shovels
3	Gas Lanterns	2	Hoes
3	Gallons Anti-Freeze	2	Double Bitted Axes
6	Canteens	2	Hatchets
2	Magnetic Compasses	1	Claw Hammer
46	Paper Plates	1	Ball Peen Hammer
12	Glass Plates	30	Large Green Salad owls
20	Knives	1	Spool of Barbed Wire
12	Bowls	10	Sleeping Cots
20	Forks	1	Dish Pan
20	Tea Spoons	5	Boxes of Alkaline Soap
3	Ladels	6	Boxes of Hot Drink Cups
3	Serving Spoons	2	Kerosene Lanterns
2	Spatulas	2	Sets Pots and Pans (Camping Kits)
1	Butcher Knife	1	Gas Cooking Stove & Stand
1	Large Serving Fork	1	Kerosene (5-Gallon Can)
2	Snake Bite Kit	1	Oil SAE 30 (5-Gallon Can)
11	Whistles	1	Large Cooler
6	S. P. Brassards	1	Large Tent
3	Serving Tongs	1	Tent Floor
1	Emergency Cutting Torch	12	Steel Wool Pads
2	Bottles Acetylene	1	Portable Water Pump
1	Bottle Oxygen	1	Sledge Hammer
1	Steel Cooking Grill	1	Wrecking Bar
4	Back Packs	1	Wire Cutter
10	Pair Gloves	1	Rip Saw
10	Camp Stools	3	Gas Spouts
2	Folding Tables	1	Fox Tail
1	Small Tent	1	Dust Pan
2	Bags Briquets (Charcoal)	1	Box Assorted Nails
8	Flashlights	5	Lbs. Fence Staples
11	Large Survival Knives	2	Pair Pole Climbers
3	Small Knives	1	Paint Brush
1	Whet Stone	2	Pkg. Mantles (Lantern)
10	Rain Jumpers	1	Chain Saw
10	Rain Pants	7	5-Gallon Jeep Cans
10	Winter Pants		
1	Gallon Detergent		
3	Rakes		
4	Long Handled Shovels		

proved unfeasible for many reasons. BuWeps authorized the purchase of a trailer locally built to design specifications of NAS Lemoore salvage personnel, costing $1150. Hand tools are carried on one side of the trailer, the other side is used to carry food. Folding sides are used as work tables. Jeep cans used for water, gasoline, and kerosene are stored on the shelf forward. An inventory list left shows the equipment carried; photos show how most of it is stored. Normally, the trailer is pulled by a 4-wheel drive salvage pick-up truck. The remainder of the convoy is composed of an additional radio-equipped pick-up and a large stake truck. After an initial survey of the crash site, other heavy equipment is called for by radio as required.

A crew normally consists of about 10 people including the salvage officer. Included is a corpsman, a photographer if needed, and a cook when possible. The station reports no difficulties have been encountered recruiting enough volunteers for the crew — usually there are more than required. Now, when the word is given to go, chow is drawn and the convoy can be on its way with a minimum delay!

Want your safety suggestion read by nearly a quarter of a million people in naval aviation? Send your constructive suggestions to APPROACH.

Letters

Re Signal Mirrors

It appears that your parachute riggahs,
Are against glass reflectors — that figgahs,
But the answer I feel
Is to use stainless steel,
Or does this idea make you sniggah.

Very resp'y,
"LIMEYMOUSE"

Seriously, sir, anything that may assist in any way in the safe recovery of ditched aircrew should be considered. In all probability stainless steel has already been suggested but if not — well, I put it to you.

CPO J. JONES, R.N.
HMS ARIEL

• Oh, Britian exporteth the Beatles
And all kinds of goodies like that.
We colonists admireth her culture,
But "stainless" is really old hat.
It scratcheth and dulleth and bendeth-
Glass mirrors are better by far.
Though they be in fragments held only by backing
They twinkleth bright as a star.
And in closing we would like to say:
We liked your lettah
But we like glass bettah.

Never Use Drain Oil, Never

NAS San Diego — The "Preoiling" article, April '64 was excellent. Information on this subject in and interesting easy-to-read form (which includes Headmouse's comments) will always be welcome by recip operators.

In this light we feel compelled to call to your attention what must have been a typographical error. Page 38 cautions that drain oil "must be used." Drain oil *should never* be reused in an engine or for preoiling.

Please furnish us with 12 copies of the April issue and anything else you may have on preoiling.

R. B. MOSS
POWER PLANT ENGINEER
O&R DEPARTMENT

• You are correct. Please make a pen and ink change to your copies that drain oil must *"not"* be reused in the engine or for preoiling other engines.

Pencil Flare Gun

Nellis Air Force Base — First let me tell you how much the pilots of the "Thunderbirds" enjoy reading your magazine. We have found through the years that flying safety only comes through diligent study, outstanding maintenance and practice. Your magazine helps to bring to mind that all services have the same safety problem as pertains to human reliability or error. We are of the opinion that *close association between maintenance and operations is the best procedure for preventing accidents.*

I have checked with our personal equipment specialist and we are very much interested in the Navy's pencil flare gun. If you could send me any information as pertains to this piece of survival equipment I would greatly appreciate it. If possible we would like to procure this item for our squadron. Thank you very much.

JERRY M. SHOCKLEY
CAPTAIN, USAF
FLYING SAFETY OFFICER

• Navy's pencil flare gun at the present time does not have a Federal Stock Number. The gun is manufactured by Penguin Associates, Pennsylvania, Ave., Malvern, Pa. Another manufacturer is Genrus Engineering Company, 1060 Vulcan Street, South Gate, Calif.

Manufacturer Concurs

Malvern, Pa. — After reading Headmouse's comments on flare gun modification in the February APPROACH, I concur wholeheartedly and sincerely appreciate his interest.

I am forwarding a catalog sheet which shows full specifications on the Survival-7 kit and confirms Headmouse's thinking. As you know, revised flight suits containing the Survival-7 kit in its bandolier configuration are being manufactured at the Naval Air Engineering Center in Philadelphia.

With regards to changing the safety/firing slot on the Penguin Launcher, we concur with Headmouse that it should not be altered. I think you will agree that the detent slot does satisfactorily prevent accidential firing by dropping the unit. We also concur that the gun should not be carried loaded.

The screwing in of the flare cartridge under adverse conditions has been expedited greatly by reducing threading of the cartridge, plus the ample lead thread section.

If there is anything further that we can do or assist with, please do not hesitate to let us know.

AUSTIN M. WORTLEY, JR.
PRESIDENT, PENGUIN ASSOCIATES, INC.

• Thank you for your interest.

"Thank You," Mr. Mechanic

Washington, D.C. — Murphy will no doubt be with us for a long time as evidenced by "101 Maintenance Goofs" in the February issue but certainly some of the foul-ups are the result of long working hours on pitching decks or on sub-zero flight lines under strong operational pressures.

Recognition of a job well done is still one of the best ways to improve aviation safety. I would therefore like to say "Thank You" to the personnel

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

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G. L. PETRE, LCDR, USN(RET)

• **Our mechanics are doing an excellent job but there *is* room for improvement.**

We've said it before and we'll say it again — maintenance goofs are published so that we may profit by mistakes of the past — criticism is never intended. See "76 Maintenance Goofs" page 34.

Lost Tail Rotor

NAS Lakehurst — Enclosed find my statement of our UH-2A accident, 16 February aboard the USS INDEPENDENCE (CVA-62), per your verbal request.

I feel that since this is the first such jet helo accident of this type, and perhaps the first tail rotor failure at night at altitude that it may serve as both a worthwhile education to all helo pilots, and good information to all others.

PAUL M. HOFFMAN
LTJG

It was a cold dark winter night on a CVA somewhere in the Mediterranean. My copilot and I decided since there were no air operations scheduled that we would do some night rescue approaches in the UH-2A jet turbine helicopter.

I lifted off, riding the right seat, and slowly transitioned to forward flight. At 200 feet indicated and 70 knots, I began a gradual right-hand turn downwind and decided to shoot one touch-and-go before attempting any rescue approaches. We leveled off at 500 feet and 90 knots and proceeded toward the 180-degree position and called the tower indicating our intentions, and requested CCA monitor the flight. They rogered.

Everything seemed normal and I turned the 90-degree about 1½ miles from the carrier when we experienced a loud muffled explosion from the engine compartment. We quickly scanned the instruments but there was no indication of trouble. I began a descent at 70 knots, called the tower for immediate landing, and turned on final.

Still no indication of our problem but my copilot, certain we were in trouble, dropped the gear and then inflated the flotation gear while I opened my door and informed the tower of our actions.

While at 50-60 knots 300 feet actually almost without warning the aircraft began to rotate to the right. My rudders had no effect and we called the ship announcing that we were going in the water. It was impossible to gain airspeed so I lowered the collective reducing power and attempted to level the helo, thus reducing the airspeed simultaneously. In one or two seconds we were spinning violently to the right like a top, while the nose was oscillating up and down. G forces were so excessive that my head was thrown out, and the horizon lights became a blur. I struggled to keep the aircraft level with no idea what altitude or airspeed we had at this time. It was black, blurred and getting worse.

Cold water was all around, we were sinking and my first reaction was to get out. We both must have blacked out because neither of us remember hitting the sea.

I do not remember releasing my lap belt and straps but reached over head for the canopy "á la Dilbert Dunker" and then realized this wasn't that type of aircraft. I swam to the right where the door should have been and recall being thankful that I had opened it prior to the spin. I was bumping into submerged parts of the plane and was unable to find the toggles on my mae west when I popped to the surface like a cork.

The other three men were yelling and getting into their rafts so I inflated my mae west and raft. Boats and lights could be seen departing the carrier in the distance. JP-5 and oil were everywhere, so I called to hold off on the flares and lit my vest light, but my copilot lit a flare anyway after finding a dud on his first try.

Our rescue was quick and uneventful although we were cold and had injured our backs and had a few cuts and many bruises.

One flattened fuel drop tank was recovered to indicate we struck the water in a somewhat level attitude.

Diagnosis — loss of tail rotor. Resultant four cold, wet, lucky pilots and crewman. Info your February 1964 article "Skill or Luck?"

• **Many thanks — readers note also "Lost Tail Rotor Thrust," April 1964. — Ed.**

Aviation and Human Variables

"Probably the most common factor among . . . all aviation or non-aviation accident categories. . . is the emerging awareness that safety specialists have been dealing with the poisonous fruits and not the seeds of accident causation, stemming from human, social, political, or economic frailties of our way of life.

"Aviation furnishes the ripest of these fruits because it contains many more variables than the others; technical and human. One need only glance through Ross McFarland's book *Human Factors in Air Transport* to determine the enormous extent of the 'human' variables that exist in aviation. The 'technical,' as well as the 'human,' variables are only vaguely known to laymen and new ones appear with uncomfortable frequency. . .

"Aviation safety is, therefore, obviously more dependent than other areas of human activity on the skill, judgment, alertness, and anticipation of the operators; it encompasses a much greater number of variables and, furthermore, it is three-dimensional, continually combatting the unrelenting force of gravity. Because aviation has so many variables, some of the refined techniques used to investigate aircraft accidents may be useful elsewhere. . .

"An exchange of information on human factors in all types of accidents should be mutually helpful. . . ."

—"Methology and Patterns of Research in Aircraft Accidents," By Jerome Lederer; Director, Cornell-Guggenheim Aviation Safety Center, Flight Safety Foundation, Inc.

approach

NavWeps 00-75-510

VOL. 9. NO. 11

Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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Page 19 B.C. by Johnny Hart, courtesy Publishers Newspapers Syndicate.

Page 30 (center) courtesy USS INTREPID (CVS-11)

Page 32 Courtesy J. Campoy, North American Aviation Co.

"Safety is not something you can get right and then put it out of your mind. It demands continuous effort and as the standards are raised, so the effort must increase for further improvement to be achieved."

—His Royal Highness The Duke of Edinburgh, to the Royal Aero-Medical Society, October 1963

Purposes and policies: Approach, published monthly by the U. S. Naval Aviation Safety Center, is distributed to naval aeronautical organizations on the basis of 1 copy per 10 persons. It presents the most accurate information currently available on the subject of aviation accident prevention. Contents should not be considered as regulations, orders, or directives. Material extracted from mishap reports may not be construed as incriminating under Art. 31, UCMJ. **Photos:** Offical Navy or as credited. Non-naval activities are requested to contact NASC prior to reprinting Approach material. **Correspondence:** Contributions are welcome as are comments and criticisms. Views expressed in guest-written articles are not necessarily those of NASC. Requests for distribution changes should be directed to NASC, NAS, Norfolk, Va. 23511 Att: Safety Education Dept., if you are receiving the magazine free because of military or commercial contract status with the Navy. . . . IF YOU ARE A PAID SUBSCRIBER, address all renewals and change of addresses to Superintendent of Documents, Washington 25, D. C. **Subscriptions:** Single copy 35 cents; 1-year subscriptions $3.50; 2 yrs., $7.00; 3 yrs., $10.50; $1.00 additional annually for foreign mailing. **Printing:** Issuance of this periodical approved in accordance with Department of the Navy Publications and Printing Regulations, NAVEXOS P-35. Library of Congress Catalog No. 57—60020.

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QUOTE

Safety is a byword; however, it is sometimes used in a general, therefore, meaningless sense. I refer, for example, to directives in the form of: "Take all necessary measures to ensure safety." We need something more.

Safety in design is as important as safety in operation. We must improve our lines of communication between the operator and the designer to firmly establish our criteria, and we must not rely complacently upon numerical reliability to furnish us with safety.

During the past year, we have instituted a program of regular liaison visits to our operating units. This direct contact with the working level has already paid dividends simply because we have found several units with outstanding and unusual techniques which we have been able to pass on to others.

We have also commenced a regular schedule of safety conferences with all of our principal manufacturers. A recent one . . . gathered together the people who fly the planes, the people who build them, those who maintain them, the officals from the Bureau of Naval Weapons who are responsible for their development, and our own specialists . . . Although the aircraft involved is widely accepted as the best in its field, the meeting . . . revealed seventy-five safety discrepancies, many of which could have been predefined. We feel that many of the positive recommendations made by such knowledgeable gatherings will prove to be of immeasurable value.

Future issues of Approach will emphasize design safety as well as "people" safety!

LIFT and DRAG

PEOPLE to the Fore in 1964!